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CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

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A suggestion for profitable use by the mills of the larger crop-ends of ingots from which rails are rolled in accordance with the proposed modified specifications comes from Robert W. Hunt, a good authority on rails. The reason for cutting off only 10 to 12 per cent. of the top of the ingot, instead of twice as much, is because this added discard means waste and reduced output. Perhaps these crop-ends can be converted into a profitable by-product. Captain Hunt's idea is to make angle-bars of them. Most of the angle-bars used at present are the same composition as ordinary soft wire rods, being made by the mills from the same ingots and rolled at the same time that the billets for the rods are produced. They are punched and sheared cold. Angle-bars made from rail ingot crop-ends would have nearly the same constituents as the rail steel; and at first thought high-carbon steel for angle-bars seems objectionable. But their use would not be a new departure, for the Canadian Pacific's angle-bar specifications are substantially those of its rail steel, with a carbon content of from 0.50 to 0.65. The Canadian Northern is also using high-carbon bars. The late A. Torrey was perhaps the first to recognize the economy of high-carbon steel in angle-bars and used them on the Michigan Central, of which he was Chief Engineer. He noted the rapid wear of soft bars, due to the motion of the rails, and the fact that they would take a permanent set and thus hold down the rail joint. He found that sometimes when the soft angle-bars were removed from a low joint the rails would spring back to a level surface. The high-carbon bars, especially those made from crop-ends, will break more readily than the others, of course, but a broken angle-bar is not a serious matter and with ordinary watchfulness no harm should result.

Still another suggestion for a profitable use of nearly all of the proposed 25 per cent. discard from the ingot comes from the chief engineer of one of the most important railroads of this country. It is that the ingot be not cropped but all of it made into the bloom and rolled to a finished rail section. Then cut from the rail 8 ft. lengths until strictly homogeneous steel, without piping, is reached. These 8 ft. lengths can be rolled into almost any imaginable section and shape for steel ties by the York cross-rolling process. It is believed that the amount of work put into the metal tie by this cross-rolling process will be quite enough to make a sufficiently strong tie, and especially for the reason that the larger rail sections rolled into steel ties have great excess strength, so that there would be a large coefficient of safety even if defective metal were used. There is one difficulty about this: No shape of steel tie has yet been devised to entirely fill the office of the wooden tie. It is necessary to secure a resiliency which will somewhat correspond to that afforded by the material of the wooden tie, the slight lateral movement of the spike in the wood and the slight canting of the rail due to the fact that it is not held with absolute rigidity to the tie. The steel tie must be made of such a form as to prevent its lateral movement in the ballast. It must also be capable of insulation, for apparently the electric track circuit for signaling purposes has come to stay. The steel tie also needs protection from rust. We have, therefore, clean cut problems for the designing engineer. If he can devise a form of steel tie that will satisfy the requirements, the cross-rolling process, either applied to old rail or to piped rail, is apparently cheap and effective.

The Pennsylvania is having a hard time satisfying the many demands of the city authorities in completing the plans for its terminal improvements in New York and Brooklyn. Last week, after long and apparently unnecessary delay, the Board of Estimate finally granted the franchise for building the Glendale cut-off, the last connecting link between the Manhattan crosstown tunnels and the New York Connecting belt line around Brooklyn, but on the same day the Municipal Art Commission rejected the plans for the Hell Gate bridge. The Commission was not satisfied with the attempted ornamentation of the massive towers flanking the great steel arch, and the architects will have to try again, which means more delay in starting the work. Since the time when Mr. Cassatt first announced the company's plans for an entrance in New York and an enlargement of the terminal facilities in Brooklyn and Long Island City the Pennsylvania has been met on every side with obstructive tactics. The Board of Aldermen held up the required franchises because the railroad refused to pay up the graft demanded. With the assistance of other powerful interests which were being obstructed in the same way, the company succeeded in having the Legislature transfer the right to grant franchises from the Aldermen to the Board of Estimate. Some of the required franchises

were quickly obtained from that body, but the New York Connecting plan was held up for nearly two years before the railroad gave in to the exorbitant demand for a payment to the city, aggregating $1,210,000, simply for the right to cross a few streets overhead in the outlying districts. The Sunnyside yard plans were similarly obstructed and the company was assessed a large sum for the privilege of closing some projected streets through land which is now a swamp. The Municipal Art Commission, however, cannot be accused of using obstructive tactics in rejecting the bridge plans. It is a disinterested body appointed for the purpose of rendering just such a verdict, if deserved, and its objections are aimed only at the artistic features of the design, not the engineering features. Nevertheless, it must be discouraging to the Pennsylvania to see every step of its work, which is really more of a public than a private enterprise, thus hampered and delayed.

THE COSTLY MISTAKE OF STATE RAILROADS

The advocates of governmental railroad ownership and control have recently been presented with a considerable amount of evidence damaging to their cause. Witnesses before the Viceregal Commission on Irish Railways have been forced to admit, in spite of their preliminary panegyrics, that on the state railroads with which they have been connected, the average level of rates and fares is higher, and the facilities given to the public lower, both in regard to freight and passenger traffic, than in Great Britain. This condition of affairs exists notwithstanding the often asseverated contention on the part of the administrations that the railroads in question are operated, in the first instance, for the benefit of the community, the earning of profits being relegated to the background, and regarded as merely incidental.

Now that is a widespread idea with regard to the administration of state-owned railroads, and is especially entertained by people who are, fortunately for themselves, without practical experience as to what the operation of a railroad system by the state really means. Perhaps one reason for the existence in England of a body pledged to the nationalization of the railroads is just the absence of real knowledge in the matter. In many respects, belief in the natural superiority of state-owned and operated railroads appears to be a matter of faith rather than of experience or reason, since the more one compares the operation of typical state and company-owned railroads, the more the disadvantages of governmental interference emerge. In this respect, E. A. Pratt, in his "State Railways," has performed a signal service in giving in striking form some facts about the price paid by a country for the theoretical benefit to be obtained by entrusting its railroads to the tender care of a government, instead of allowing the healthy competition inseparable from private enterprise.

The greater part of this book is taken up with a translation of some excellent recent articles on the Belgian state railroad administration. Belgium is a country that at first sight would appear particularly suited for the development of a highly successful railroad system. It is small, compact and densely populated, manufactures and agriculture are alike highly flourishing, the distribution of the population is fairly even, and from the engineering standpoint the flatness of the country offers no great difficulties to the laying out of railroads, thus enabling them to be both cheaply built and worked. The upholders of the state railroad superstitition have consequently always pointed to Belgium as a country in which government control was working admirably, and it has been regarded by these individuals, including many Englishmen, as a sort of railroad paradise. As a matter of fact, the system, without exception, is defective in every detail in which a state railroad theoretically excels.

The average standard of pay, both of the uniformed staff and of the higher officers, is very low, not only as compared with English standards, but in comparison with the rest of the Continent. In spite of this, an excessive amount is spent on wages and salaries, owing to the great overstaffing that takes place in every department, which, however, does not prevent the hours being enough to make the hair of the Board of Trade stand on end. The state railroads employ approximately half as many men again per mile as the private Belgian companies. This overstaffing has invariably been one of the evils of government departments, and an interesting sidelight on the matter is provided by the statement that the red-tape regulations of the Belgian service provide for the employment of the same number of men at stations of the same class, regardless of the respective traffic handled by them.

Apart from the question of wages and hours, the Belgian state, at any rate where its railroads are concerned, is a bad employer of labor. In the matter of pensions, and traveling facilities, such as privilege tickets, it is niggardly in the extreme. The administration has even gone to the length of repudiating obligations into which it has entered when taking over the private companies, whose employees had already been contributing to superannuation and pension funds, and who apparently lost their contributions when the state acquired the undertakings by which they had formerly been employed. Should an employee bring a claim against the administration for personal injuries, it will be resisted as much as possible, and in the event of the courts deciding in favor of the employee, a loophole by which the responsibility may be evaded is always sought. These conditions are the more striking when it is borne in mind that the Socialist party is numerically very strong in the Belgian parliament, and is continually ventilating the grievances of the staff.

After this description of the treatment of its men, no one will be surprised to learn of the cavalier attitude adopted by the administration towards the general public. The passenger fares may be low, but they have to be considered in the light of the low speed of the trains, the infrequency of the service, the inadequate accommodation given at many of the stations, and the general drawbacks to "passenger comfort." No new train is ever put on except under strong pressure, and until the Minister of Railroads has satisfied himself that it will be run at a profit. This latter condition is, of course, perfectly reasonable in itself, but it must often be incompatible with the theory that on a state railroad the convenience of the public is the first consideration, and the question of profit a secondary matter.

The freight service appears to be even worse than the passenger. The conveyance of merchandise is slow and uncertain, and the shortage of locomotives and wagons so chronic that it does not excite special remark, except at times of particularly heavy traffic, when traders and the country in general are put to worse inconvenience than usual. On occasion, the administration has even been obliged to resort to the desperate expedient of refusing to receive any fresh consignment whatsoever for a period of three days, until the existing congestion had been somewhat reduced. In this particular instance it is clear that the congestion was less due to abnormal and unexpected traffic than to general disorganization and failure to make provision for the acquisition of sufficient rolling stock. A general complaint is that the red-tape regulations of the service have produced a cast-iron system under which any concession that would lead to the encouragement of a particular industry or district is practically ignored.

Glib writers on the alleged defects of private railroads have held up the low Belgian freight rates as an admirable example. Now the truth about Belgian rates is that they are only low in the case of through joint rates with foreign countries, and for journeys, such as between England and the Continent, where a certain small proportion of the total transit is made across the Belgian lines. Here low rates are compulsory on account of the competition of other Continental railroads, German, French and Dutch, and of water transport. Local rates in Belgium itself, that is the rates vitally affecting the domestic commerce of the country, are high when judged by any standard. The coal rates for distances of 9¼ to 16¼ miles are, for example, 6.2 to 10.4 cents higher on the Belgian state railroads than on the Eastern of France. This fable of the low freight rates charged in Belgium deserves to be universally recognized as only a fable.

It might perhaps be imagined that the financial results of state operation are favorable, especially as every effort is made to earn as large a profit as possible. The actual financial position of the system, like that of practically every other Continental state railroad, it is impossible to know, but it has been proved within recent years that the net earnings are appreciably less than had been assumed. Accounts, in the real sense of the word, are non-existent, although their place is taken by voluminous statistics, containing pages of perfectly unnecessary details. The railroad accounts are distributed under five separate and distinct budgets, considerable sums being charged to general public expenditure. It may be doubted whether anyone, even the Minister of Railroads, knows exactly how much the railroads cost to work, or their value as a going concern. One definite fact has been brought out by a report which has recently been drawn up by M. Hubert, Deputy of the Right, at the request of the Belgian Chamber. This clearly shows one very disquieting feature, the constant rise in the ratio of expenditure, which appears to be gradually swallowing up the profits of the system, in spite of the way in which the roads are starved by lack of adequate rolling stock and station accommodations and

notwithstanding the high rates charged. The report shows that in 1905, while the traffic receipts increased by 15,170,000 francs ($3,034,000), the rise in expenditure amounted to 15,570,000 francs ($3,114,000). M. Hubert goes on to sound a warning with regard to the future, by saying that in the event of a general trade depression, which would result in reduced traffic, the cost of operating the system could not be reduced, and the result would be a heavy loss from operation. According to this report, the chief causes for the increased expenditure are the lack of unity in the management of the lines and the crushing out of all spirit of initiative among the staff by the uniformity of salaries, defects which characterize most forms of state enterprise.

Possibly the worst feature of the entire administration is the interference of politics with an undertaking that should be conducted on a purely commercial basis. A very large part of the time of the Belgian parliament is taken up by members' complaints or suggestions with regard to the railroad service, the railroad budget is discussed for weeks, and every trifling question affecting the railroads is unnecessarily ventilated in parliament. The loss of time involved by this proceeding is obvious, and in spite of the great attention given by the parliament to railroad matters, it appears to be only on very rare occasions that any tangible results are obtained. Favoritism, largely due to political considerations, is rampant in the service, and the employees are practically forbidden to join political or labor unions, although the constitution expressly gives them the right to do so, unless the organization is one in harmony with the views of the government for the time being, in which case the men's political activity is winked at.

The above brief analysis of some of the most outstanding defects of the Belgian state railroad administration could be carried to much greater length, without presenting a complete indictment of the system. What must be appreciated is, not that the administration of the Belgian railroads is too expensive, that the facilities given to the public are insufficient, that the status of the employees is worse than those working for private corporations, that political considerations tend to have greater weight than the social and industrial welfare of the country, and that the accounts are so juggled with as to be absolutely unreliable, but that all these defects are the logical outcome of state interference with an essentially commercial undertaking.

Per se, no commercial enterprise has ever failed to suffer on the state assuming control. The use of a government department for purposes of party politics, the cast-iron system evolved from red tape and the lack of initiative inseparable from the average government official, the political influence that can be exerted by its employees and by labor leaders agitating for their own benefit, the disregard of the public caused by assuming that the public exists for the benefit of the department instead of being its master, the ease with which accounts can be cooked and responsibility evaded for financial or administrative blunders, and the lack of healthy competition, can all be expected to characterize a system of railroads owned and controlled by the state. On the Belgian state railroads, so long upheld as a model, these conditions have been proved to underlie every branch of the administration. It is consequently a service of some value to make public the truth regarding this system of state railroads, which may be regarded as typical.

THE SETTLEMENT OF FREIGHT CLAIMS.

W. B. Biddle, Vice-President of the Chicago, Rock Island & Pacific, in a circular to the patrons of his road, warning them that nothing is gained by employing agents to collect claims against the road, says that he and his fellow officers are making an earnest effort to improve their treatment of both local and interline claims; that many subordinate traffic officers have authority to settle some classes of claims on presentation, and that the company intends to give as careful attention to claims against it as to cases where the company has claims against other people. He admits that the railroads have not done justice to the matter of settling claims, but the managing officers of the Rock Island are now taking a personal interest in the work and hope to establish a reputation for promptness and fair dealing. Colonel H. G. Prout, Vice-President of the Union Switch & Signal Co., in an address which was printed in the *Railroad Gazette* July 19, told the traffic men some plain truths, which indicate that on some railroads the conditions are bad. To Colonel Prout the claim department seems to be a highly efficient organization for obstruction. He evidently finds little disposition by claim agents to learn the truth by judicial process, or to take a kindly attitude toward claimants. He protests against "being considered a swindler" until, at great pains, he proves himself to be an honest man.

The settlement of freight claims on a large railroad is a slow task at best, and the machinery of the freight claim office will always be subject to heating by friction however well it may be oiled. A claim requiring three weeks to investigate often seems to the claimant so simple that he is surprised at the delay. The surly agent who curtly tells the consignee that the other road is to blame for the delay, not seeing that he ought to apologize for the other road as carefully as for his own, would still fail to give satisfaction if he were polite and explanatory and took only the necessary time to settle interline claims. The question which will interest railroad officers is how fully can Mr. Biddle and other well-disposed railroad managers carry out their purpose to cure all the causes of Colonel Prout's complaint?

The interesting paper by the Freight Claim Agent of the New York Central, which is reprinted in this issue, does not throw much light on the actual work of settling claims. Mr. Calkins tells of some of the things that cause damage and thus originate claims; and he reminds us that the competent claim agent will be able to make friends of claimants even if they do have to wait a long time for their money; but the means of expediting the machinery he hints at: (1) Thorough system, devoid of circumlocution; (2) prompt investigation; (3) uniformly business-like treatment of claimants; (4) avoidance of disputes about small claims where no important principle is involved. These hints, however, suggest a number of pertinent questions.

To take the last point first, there is little doubt that a railroad could make friends whose friendship would be valued in dollars, by paying many small claims, presented by reputable people, without standing on its full rights—just as the great fire insurance companies do. This is the frequent method of settling for injuries to passengers. Of course, if such policy were followed in the freight department the fact that rights were being waived with the reason should be distinctly stated and even advertised. It is to be remembered that when the owner of damaged or delayed freight receives his full legal claim he still suffers in many cases a further loss for which the law will not allow him to recover.

Uniformly business-like treatment of claimants implies a competent agent or clerk at every station, and this is only partially attainable. In this connection we recall the highly commendable suggestion of one claim agent that every large station should have a claim clerk who has been trained in the general claim department; who perhaps should report direct to the general claim agent. Such a clerk could handle the claims presented at other stations within say 50 miles and thus save some time and possibly much friction.

Steady uninterrupted progress, almost daily progress, toward settlement is the desideratum. It requires time, but time need not be wasted in careless reading of letters or delay in answering them. A wideawake claim agent needs not much instruction or exhortation concerning the design or construction of his office machinery; but evidently a great many claim agents need to learn how to make their machinery move continuously. Do you answer all possible letters on the day of receipt? Do you know that this is easier, takes less of your time, than to allow letters to accumulate?

Much of the delay complained of is due to the dulness or inattention of men who do not carefully read letters received, or intelligently compose letters sent. They answer questions not asked and ignore the intent of inquiries. This causes additional letter writing and more days of delay in settlement. Premiums for excellence in letter writing, properly advertised among the clerks, might produce an improvement. Besides accuracy and promptness, clerks may cultivate courtesy. "Politeness is a requirement," said General Devereaux in an address to trainmen when he was President of the Big Four. It is especially useful in dealing with customers whose claims must be rejected. Mr. Calkins speaks of inducing claimants to see the railroad's side of a case, even when they are feeling disgruntled. Extreme courtesy by the company's representative is the only means to this end.

Revised Signaling Rules of the Belgian State Railroads.

The Bulletin of the International Railway Congress for July contains an article on the Convertible Semaphore Signal which is the standard of the Belgian State Railroads, and the description is prefaced by an extract from the new general signal rules of the State railroads, which are now in press. The article is by L. Weis-

senbruch, editor of the *Bulletin*, who also is Chief Engineer of Signaling and Safety Appliances of the State railroads.

The standard semaphore is a box girder made up of four angles and stiffened with horizontal lattice members. The fittings are so designed as to make all parts interchangeable for use with one or more arms, and with arms on either side of the post. For the support of the lamp or lamps a wire rope is provided, controlled by a windlass near the bottom of the post. The foundation is of cast-iron set in concrete. Provision is made for the use of indicators to show by a letter or number the track for which a signal arm is cleared. The use of indicators seems to be regular standard practice. They are to be used for speed up to 25 miles an hour. The spectacles for the night color indicators are separate from the arm, and are controlled by stops on the arms. These stops are so arranged that the light shows "proceed" a little after the movement of the arm, while it returns to "stop" a little in advance of the arm.

The new signal regulations, which, it would appear, have to do chiefly with future installations, seem to be in some respects tentative. Signal arms are always on the left of the post and signals usually at the left of the track. At a station a home signal arm with a notched end, like our distant signal, indicates a full speed or main line route, while the ordinary square end (full size) is used for movements to diverging tracks. In all new work bracket signals—called there "candle stick" signals—are to be used for diverging routes, a separate post for each route. For distant signals the arm has a pointed end, like that which has been adopted on the New York Central and some other American roads for automatic stop signals. Where two or more arms are on one post the upper arm applies to the high speed route in every case. No dwarf posts are shown, but short arms are used for low-speed movements in the normal direction, while for "back up" movements the shape of the arm is that of two triangles joined at the vertices. The upward inclination is prescribed for new semaphores, but the old signals, having downward inclination, have not been changed as "experience has shown that this difference causes no trouble whatever to the enginemen."

Green has been adopted for the night "all clear" indication and the process of taking out the white lights, heretofore used, is now going on. Back lights will, in future, be made visible only when the arm is in the stop position, and they will be either a small white light or a violet light. Block signals are to be fitted with an arrangement for automatically placing a torpedo on the rail when the arm is horizontal, but it does not appear from the present description to what extent automatic torpedoes are or will be used. At stations, as before stated, a notched arm indicates a high-speed route and a square end arm a lower speed; this difference is indicated at night by showing a double green light for the notched arm (in the proceed position).

In distant signals at night, the signal when "on" will show a red light side by side with a green light, or it will show a yellowish orange light. Where the red-and-green is used the clearing of the arm will make two green lights visible; while with the orange light a single green light is used for "all clear." With this last arrangement (an orange light and a single green light) there will be provided a fixed audible warning 227 ft. in the rear; or a repeating light will be thus fixed, to be lit only in time of fog. This light will show orange and green the same as the regular distant signal. This arrangement appears to be subject to confirmation after further experiments shall have been made.

The standard rules have a provision for putting up white posts along the side of the track a short distance apart approaching a caution signal; this to seasonably attract the attention of the engineman.

As a rule the number of arms on any one post must be limited to three. The State proposes to rearrange all junctions so that trains will not have to slacken speed; this done, the notched arm and the double green light can be done away with. At interlockings, where necessary or desirable, a semaphore is fixed at the outgoing end of the section of track for which the interlocking signals give indications. This seems to be designed chiefly or wholly as a limit mark and not an independent starting signal.

As Belgian signal engineers are careful students of English, German and American practice this new code, of which we have given the salient features, may be taken as an instructive exhibit of what unprejudiced observers have found worth copying from the devices and practices of the different countries. We are unable to make out just how far the several innovations have been decided upon for permanent use, but even as tentative propositions they will be found of interest by American railroad officers. The free use of bracket signals is an English idea that most Americans will not accept, but some of the other changes have features well worthy of consideration. The use of both upward and downward inclinations on the same railroad should reassure some nervous Americans. The distant signal improvements evidently have been taken mostly from American practice; while in the use of double green lights, warning signals in the rear of distants, and white fence posts, Americans may well learn from Europe.

The order for distributing coal cars in Ohio recently issued by the Interstate Commerce Commission, and reported in our news columns to-day, looks like a fine example of Dutch justice; and readers will be interested to see the full report on the case and learn how Commissioner Clark makes this kind of justice match with that kind which is supposed to underlie the law that a railroad must furnish all the cars necessary to do the business offered by shippers along its lines and must treat all shippers alike. Quite likely, when cars are scarce, Mine *A*, receiving 25 Pennsylvania cars to load with coal for the Pennsylvania's locomotives, can get along without any Hocking Valley cars and suffer less than will Mine *B* even when 10 or 15 H. V. cars are delivered to it. Moreover, as the coal road—the Hocking Valley, for example—pays for its use of the private or specially assigned cars there is a semblance of fairness in compelling it to treat such cars for the purpose of distribution, as though they were its own. But the other view is equally plausible. Suppose Mine *A* concludes to double its capacity, and to use the increased capacity, not for Pennsylvania Company's coal, but for the general market. Should not the railroad company provide cars for this market coal the same as it furnishes them for market coal from any other mine? Does a coal operator who buys cars in which to ship his coal thereby relinquish his right to being served by all common carriers on an equality with every other shipper?

CONTRIBUTIONS

M. C. B. Tests of Brake Shoes.

Mahwah, N. J., July 30, 1907.

To the Editor of the Railroad Gazette:

The table and diagrams presented in the report of the standing committee on brake shoe tests of the M. C. B. Association at the last convention while clear to many of those who have followed closely the work and reports of the committee, do not, in the opinion of the writer, give sufficient information to enable comparisons to be made between the various shoes tested.

The table which I submit herewith is part of my discussion on the subject, and is intended to supply some information in detail to supplement the committee's report. I realize that the committee's report is in the nature of a preliminary one intended to show what the brake-shoe testing machine can do in regard to defining the relative durability and wearing qualities of brake-shoes. It is important in the study of the question to take into account not only the surface of insert and hard metal on the face of the shoe, but also the volume of each, realizing that the durability of the brake-shoe depends largely on the percentage of hard and tough material in

No. of Shoe	Trade Name of Shoe	Description of Shoe	Area of Shoe Face in square inches	Percentage of Shoe Face: Inserts	Chill	Unchilled Cast Iron	Comparative Durability. Million foot-pounds of work done per 1-16 of Shoe Wear	Shoe Tested, Made by	Shoe Tested, Furnished by	Graphical Record of Shoe Wear. In Million foot-pounds of work absorbed per one pound of material worn away. (100 200 300 400 500 600)	Mean* Coefficient of Friction, percent	Number of Shoe
175	Plain cast iron	Unchilled soft cast iron, no inserts	45	0	0	100	80.8	Griffin Wheel Co.	W. & L. E.		30.3	175
205	" " "	" " " " " "	47	0	0	100	92.0	Gm. Bk. Shoe & Fdy. Co.	L. S. & M. S.		23.5	205
179	Pittsburg (Mal)	Malleable iron shell, composition filling	44	Mal iron 38	Comp 64	0	114.3	Pitts. burg Bk. Shoe Co.	W. & L. E.		36.8	179
161	Streeter	Cast iron body, white iron inserts	51	32	0	68	149.6	Gm. Bk. Shoe & Fdy. Co.	H. V.		21.8	161
186	Congdon	" " " wrot steel inserts	47	13	0	87	162.5	" " " " "	D. M. & N.		24.1	196
209	"U"	" " " tapered ends chilled	54	0	13	87	172.0	" " " " "	L. S. & M. S.		24.7	209
183	Pittsburg (Steel)	Pressed steel shell, composition filling	45	Pri. steel 22	Comp. 78	0	173.8	Pittsburg Bk. Shoe Co.	D. M. & N.		38.7	183
178	Plain cast iron	Unchilled hard cast iron	48	0	0	100	227.7	Gm. Bk. Shoe & Fdy. Co.	W. & L. E.		20.0	178
172	Hard insert (Seaton)	Cast iron body, wrot steel inserts, boiler plate punchings	45	12	0	88	258.2	Seaton Fdy. Topeka Kan.	A. T. & S. F.		22.8	172
215	Congdon	Cast iron body, wrot steel inserts	47	18	0	84	270.9	Gm. Bk. Shoe & Fdy. Co.	D. S. S. & A.		20.9	215
163	"U" Dia "S"	Cast iron, ends chilled, soft steel inserts	53	30	13	57	350.1	" " " " "	A. T. & S. F.		21.7	183
200	Streeter	Cast iron body, white iron inserts	45	37	0	63	387.0	" " " " "	L. S. & M. S.		22.7	200
158	"	" " " " " "	51	32	0	68	407.2	" " " " "	H. V.		22.5	158
220	Congdon	" " " wrot steel "	48	25	0	75	504.7	" " " " "	C. & A.		26.5	220
194	"	" " " " " "	47	40	0	60	554.6	" " " " "	L. S. & M. S.		26.5	194

Speed constant at 20 miles per hour. Pressure of shoe on wheel 2808 pounds. Revolutions of wheel during application 150. Equivalent distance run during application 1841-5 feet.

* Mean Coefficient of Friction is obtained from tests of the various shoes in question on chilled wheels under a load of 2808 pounds stopping the wheel from a speed of 40 miles per hour.

Comparative Composition and Durability of Brake Shoes.

The standard semaphore is a box girder made up of four angles and stiffened with horizontal lattice members. The fittings are so designed as to make all parts interchangeable for use with one or more arms, and with arms on either side of the post. For the support of the lamp or lamps a wire rope is provided, controlled by a windlass near the bottom of the post. The foundation is of cast-iron set in concrete. Provision is made for the use of indicators to show by a letter or number the track for which a signal arm is cleared. The use of indicators seems to be regular standard practice. They are to be used for speed up to 25 miles an hour. The spectacles for the night color indicators are separate from the arm, and are controlled by stops on the arms. These stops are so arranged that the light shows "proceed" a little after the movement of the arm, while it returns to "stop" a little in advance of the arm.

The new signal regulations, which, it would appear, have to do chiefly with future installations, seem to be in some respects tentative. Signal arms are always on the left of the post and signals usually at the left of the track. At a station a home signal arm with a notched end, like our distant signal, indicates a full speed or main line route, while the ordinary square end (full size) is used for movements to diverging tracks. In all new work bracket signals—called there "candle stick" signals—are to be used for diverging routes, a separate post for each route. For distant signals the arm has a pointed end, like that which has been adopted on the New York Central and some other American roads for automatic stop signals. Where two or more arms are on one post the upper arm applies to the high speed route in every case. No dwarf posts are shown, but short arms are used for low-speed movements in the normal direction, while for "back up" movements the shape of the arm is that of two triangles joined at the vertices. The upward inclination is prescribed for new semaphores, but the old signals, having downward inclination, have not been changed as "experience has shown that this difference causes no trouble whatever to the enginemen."

Green has been adopted for the night "all clear" indication and the process of taking out the white lights, heretofore used, is now going on. Back lights will, in future, be made visible only when the arm is in the stop position, and they will be either a small white light or a violet light. Block signals are to be fitted with an arrangement for automatically placing a torpedo on the rail when the arm is horizontal, but it does not appear from the present description to what extent automatic torpedoes are or will be used. At stations, as before stated, a notched arm indicates a high-speed route and a square end arm a lower speed; this difference is indicated at night by showing a double green light for the notched arm (in the proceed position).

In distant signals at night, the signal when "on" will show a red light side by side with a green light, or it will show a yellowish orange light. Where the red-and-green is used the clearing of the arm will make two green lights visible; while with the orange light a single green light is used for "all clear." With this last arrangement (an orange light and a single green light) there will be provided a fixed audible warning 227 ft. in the rear; or a repeating light will be thus fixed, to be lit only in time of fog. This

As Belgian signal engineers are careful students of English, German and American practice this new code, of which we have given the salient features, may be taken as an instructive exhibit of what unprejudiced observers have found worth copying from the devices and practices of the different countries. We are unable to make out just how far the several innovations have been decided upon for permanent use, but even as tentative propositions they will be found of interest by American railroad officers. The free use of bracket signals is an English idea that most Americans will not accept, but some of the other changes have features well worthy of consideration. The use of both upward and downward inclinations on the same railroad should reassure some nervous Americans. The distant signal improvements evidently have been taken mostly from American practice; while in the use of double green lights, warning signals in the rear of distants, and white fence posts, Americans may well learn from Europe.

The order for distributing coal cars in Ohio recently issued by the Interstate Commerce Commission, and reported in our news columns to-day, looks like a fine example of Dutch justice; and readers will be interested to see the full report on the case and learn how Commissioner Clark makes this kind of justice match with that kind which is supposed to underlie the law that a railroad must furnish all the cars necessary to do the business offered by shippers along its lines and must treat all shippers alike. Quite likely, when cars are scarce, Mine *A*, receiving 25 Pennsylvania cars to load with coal for the Pennsylvania's locomotives, can get along without any Hocking Valley cars and suffer less than will Mine *B* even when 10 or 15 H. V. cars are delivered to it. Moreover, as the coal road—the Hocking Valley, for example—pays for its use of the private or specially assigned cars there is a semblance of fairness in compelling it to treat such cars for the purpose of distribution, as though they were its own. But the other view is equally plausible. Suppose Mine *A* concludes to double its capacity, and to use the increased capacity, not for Pennsylvania Company's coal, but for the general market. Should not the railroad company provide cars for this market coal the same as it furnishes them for market coal from any other mine? Does a coal operator who buys cars in which to ship his coal thereby relinquish his right to being served by all common carriers on an equality with every other shipper?

CONTRIBUTIONS

M. C. B. Tests of Brake Shoes.

Mahwah, N. J., July 30, 1907.

To the Editor of the Railroad Gazette:

The table and diagrams presented in the report of the standing committee on brake shoe tests of the M. C. B. Association at the last convention while clear to many of those who have followed closely the work and reports of the committee, do not, in the opinion

the insert rather than on the surrounding body metal, which may be soft cast-iron acting as a holder for the inserts, and that 90 per cent. of the life of the shoe may be comprised within the period necessary to wear out the insert.

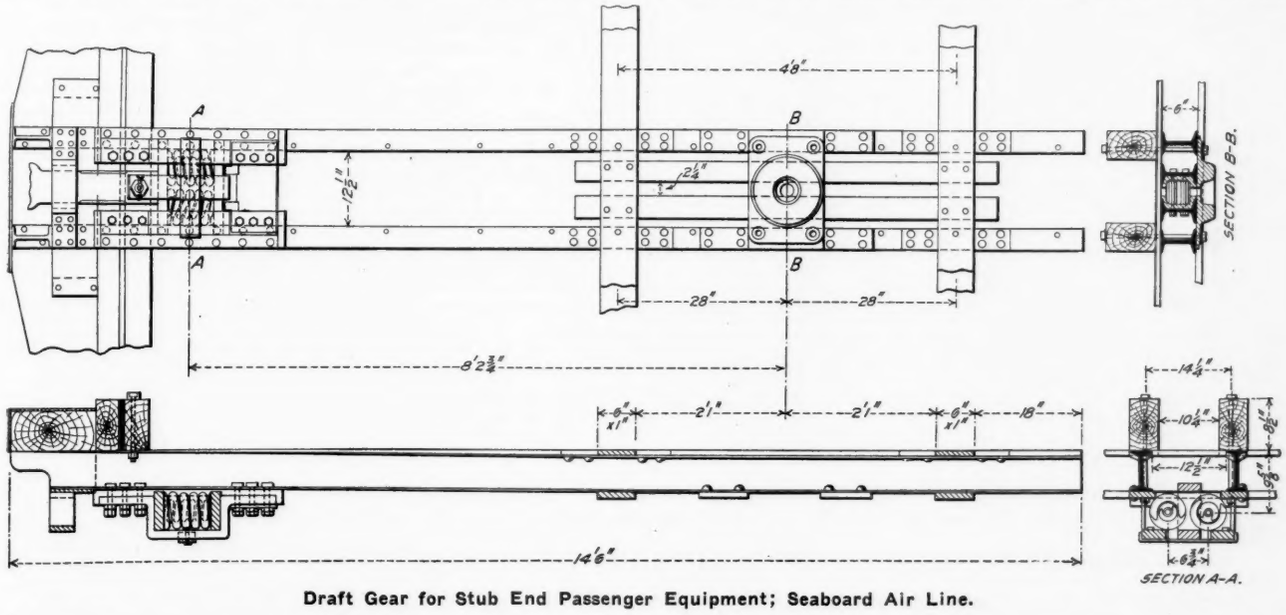
In the case of the records in question, some of the tests were made on shoes in which inserts had been worn through or had fallen out, and of course such records are not true indications of the performance of the original shoe; for that reason this new table has been prepared, which takes into consideration the actual conditions on the face of the shoe during the test. With this clearly understood, the column of comparative durability can be fairly considered.

Will you kindly publish this explanation and table for the information of those interested?

F. W. SARGENT,
Chief Engineer, American Brake Shoe & Foundry Co.

Draft Rigging for Stub-End Passenger Equipment.

The Seaboard Air Line is using a composite arrangement of steel beams for draft rigging on stub-end passenger equipment that is working well. The drawbar attachments themselves are of the twin-spring type and are riveted to and below the draft sills. The draft sills are directly below the wooden center sills of the car and are made of 6-in. I beams weighing 17¼ lbs. per foot. These beams run back 4 ft. 1 in. beyond the center plate and 1 ft. 9 in. beyond the center of the inner body bolster. There are two body bolsters of the plate type which are set 4 ft. 8 in. apart and equally spaced on each side of the center plate. The draft sills pass between the plates of the bolsters. In addition to the draft sills there are two 6-in. I beams set between them, as shown at the section on B B in the drawing, which are also riveted to the bolsters and which with the draft sills serve as a bearing for the center plate and so carry the car body. With this arrangement the end of the car framing is relieved of the buffing stresses which are carried back and distributed.



Draft Gear for Stub End Passenger Equipment; Seaboard Air Line.

Holding Power of Railroad Spikes.

BY ROY I. WEBBER, C. E.*

The determination of a proper fastening between the rail and the tie has become a matter of considerable importance. As long as the supply of suitable hard wood timber was sufficient, the ordinary spike satisfactorily fulfilled the requirements; but with increase in the amount of traffic handled and the heavier weights of cars and locomotives, and also with the use of soft deciduous and coniferous woods for ties, the common spike has proved deficient. Variations in the form of the ordinary spike have been developed, and new forms of spikes have been devised in an attempt to overcome the loss of efficiency attendant upon the use of inferior timbers. In view of these conditions, and the meager supply of published data on the holding power of spikes in ties, the writer has carried out a series of experiments to determine the resistance to withdrawal offered by the same type of spike in different timbers and by different forms of spikes in the same timber, and also to determine whether or not the preservative has any influence upon this resistance.

*Instructor in Civil Engineering at the University of Illinois. Published in Bulletin No. 6 of the University of Illinois Engineering Experiment Station.

The writer wishes to express his thanks for the hearty cooperation received from the various persons, firms and corporations mentioned in the text. He wishes also to express his indebtedness for personal aid, to Robert Trimble, Chief Engineer Maintenance of Way, Pennsylvania Lines West (Northwest System); George E. Boyd Roadmaster of the Illinois Central; A. L. Kuehn, Superintendent of Maintenance of Way of the Cleveland, Cincinnati, Chicago & St. Louis; Dr. Octave Chanute, President of the Chicago Tie Preserving Company, Chicago, Ill., and to Prof. Ira O. Baker and Prof. C. H. Hurd, of the University of Illinois.

The ties used in these experiments were furnished gratuitously as follows: Nos. 1 to 11 and 16 to 30 by the Chicago Tie Preserving Company; Nos. 12 to 15 by the Illinois Central; Nos. 31 to 41 by the Cleveland, Cincinnati, Chicago & St. Louis. Table I gives a description of the several ties used. The ties were taken either from the stock pile of the railroad companies or from those of the treating plant. No attempt has been made to trace their history farther back than the place of growth and date of treatment. Treated ties were used in a majority of the experiments, since in the future as the inferior grades are pressed into service, the tendency will doubtless be toward the use of preserved timber.

TABLE I.—*Description of the Ties.*

No. of tie.	Kind of timber.	Kind of treatment.	Date treated.	Remarks.
1.	Blue ash.	Zinc-creosote.	1905.	Seasoned; sound.
2.	Blue ash.	Zinc-creosote.	1905.	Seasoned; sound.
3.	Sweet gum.	Zinc-creosote.	1904.	Seasoned; sound.
4.	Water oak.	Zinc-tannin.	1904.	Seasoned; sound.
5.	Water oak.	Zinc-tannin.	1904.	Seasoned; sound.
6.	Red oak.	Zinc-tannin.	1904.	Seasoned; sound.
7.	Red oak.	Zinc-creosote.	1905.	Seasoned; sound.
8.	Red oak.	Zinc-creosote.	1905.	Seasoned; sound.
9.	Red oak.	Zinc-tannin.	1904.	Seasoned; sound.
10.	Rock elm.	Zinc-creosote.	1905.	Seasoned; sound.
11.	Poplar.	Zinc-creosote.	1905.	Seasoned; sound.
12.	Elm.	.....	.....	Seasoned; sound.
13.	Elm.	.....	.....	Seasoned; sound.
14.	Beech.	.....	.....	Seasoned; sound.
15.	Elm.	.....	.....	Seasoned; sound.
16.	Black oak.	Zinc-creosote.	1902.	Seasoned.
17.	Red oak.	Zinc-creosote.	1902.	Seasoned.
18.	Black oak.	Zinc-creosote.	1902.	Seasoned.
19.	Poplar.	Zinc-creosote.	1902.	Seasoned.
20.	Loblolly pine.	Zinc-tannin.	1905.	Treated Dec., 1905; sound.
21.	Loblolly pine.	Zinc-tannin.	1905.	Treated Dec., '05; sound.
22.	Red oak.	Zinc-tannin.	1905.	Treated Dec., '05; split.
23.	Black oak.	Zinc-tannin.	1905.	Treated Dec., '05.
24.	Black oak.	Zinc-tannin.	1905.	Treated Dec., '05.
25.	Water oak.	Zinc-tannin.	1905.	Treated Dec., '05.
26.	Water oak.	Zinc-tannin.	1905.	Treated Dec., '05.
27.	Black oak.	Zinc-tannin.	1905.	Treated Dec., '05.
28.	Red oak.	Zinc-tannin.	1905.	Treated Dec., '05.
29.	Water oak.	Zinc-tannin.	1905.	Treated Dec., '05.
30.	Red oak.	Zinc-tannin.	1905.	Treated Dec., '05.
31.	White oak.	.....	.....	Seasoned; in track 2 years.
32.	White oak.	.....	.....	Ind. oak; sap wood showed slight decay.
33.	White oak.	.....	.....	Ga. oak; seasoned; sound.
34.	Water oak.	Creosote.	1904.	Sound.
35.	Burr oak.	Creosote.	1904.	Sound.
36.	Beech.	Creosote.	1904.	Sound.
37.	Elm.	Creosote.	1904.	Sound.
38.	Beech.	.....	.....	Sound.
39.	Loblolly pine.	.....	.....	Seasoned; sound.
40.	Chestnut.	.....	.....	Seasoned; sound.
41.	Red oak.	Creosote.	1904.	Showed tendency to split.
42.	Beech.	.....	.....	Sound.
43.	Beech.	.....	.....	Sound.
44.	Beech.	.....	.....	Sound.

Two distinct lines of experiments were undertaken: (1) Determination of the resistance to direct pull of several forms of spikes; and (2) Investigation of the resistance to lateral thrust.

Therefore, the paper naturally divides itself into two parts: Part I, Resistance to Direct Pull; Part II, Resistance to Lateral Displacement. All of the experiments were made in the Laboratory of Applied Mechanics, University of Illinois.

PART I—RESISTANCE TO DIRECT PULL.

The experiments were made with a Riehle 100,000-lb. testing machine. The pulling device for ordinary spikes was a Verona spike-puller threaded into a piece of steel gripped between the lower jaws of the machine; the pulling device for the screw spikes was of the same general pattern and was designed especially for these tests. A scale graduated to 1-16 of an inch was so set that the distance moved through by the lower head of the machine could be measured directly. A load of 500 lbs. was applied to insure the tie's having a good bearing before any records were taken. The machine was geared to move at the rate of ⅝ in. per minute, which allowed time for carefully balancing the machine and for taking the readings of the scales. Five observations were usually taken, viz., when the lower head of the machine had moved through ⅛, ¼, ½ and ¾ of an inch, and also at the point at which the maximum fiber resistance was developed. No observations were made after the spike had been pulled ¾ in., as it would have lost its usefulness long before that point had been reached.

Further consideration of this part of the paper will be continued under the following heads: Holding Power of Ordinary Spikes; Holding Power of Screw Spikes Without Linings.

HOLDING POWER OF ORDINARY SPIKES.

The ordinary spikes were received from the following companies, the numbers in this list being the designations in the subsequent tables: Nos. 1 and 2 from the Pennsylvania Lines West; Nos. 3 and 4 from the American Iron and Steel Manufacturing Company, Scranton, Pa.; Nos. 5 to 10 from Dillworth, Porter & Co., Pittsburg; No. 11 from the W. A. Zelnicker Supply Company, St. Louis, and Nos. 12 to 14 from the Illinois Steel Company, Chicago.

The nominal dimensions of the four sizes of spikes are shown in Table II. The actual lengths varied considerably from the nominal lengths, usually being less. This was particularly true of the 6-in. spike. The actual cross sections were nearly the same as the nominal, the variation in thickness rarely being over 1-64 of an inch. As the range in thickness of the spikes was only 1-16 in., some experiments were made with plain, square and chisel-pointed bars ½, ¾ and ⅞ of an inch thick to determine the relation between the holding power and the cross section. The spikes had differently shaped points, as shown in Table II. Three spikes were used for each experiment, and these three were always of the same size and lot number. The spikes were driven by an experienced track foreman detailed for this purpose by the division engineer of the Big Four. Whole ties were used to insure freedom from splitting in driving the spikes, and care was exercised to avoid driving the spike into knots or cracks. The spikes were driven into the tie to a depth of 5 inches. In some instances, as shown in the record, holes were bored for the ordinary spikes, the hole being 1/16 or ⅛ in. less in diameter than the cross sectional dimensions of the spike. The depth of the boring was not quite as great as the depth of insertion, so that the pointed end of the spike was forced into the undisturbed wood. Figures 1 and 2 show graphically the curves of average resistances of the different ties, as developed by the tests.

TABLE II.—*Description of the Ordinary Spikes.*

Record No.	Nominal length, ins.	Section, ins. sq.	Area, ins. sq.	Type of point.	Depth inserted.	Condtn of surface of spike.
1.	6	⅝	0.372	Chisel.	5 ins.	Smooth.
2.	5½	⅝	0.372	Chisel.	5 "	"
3.	5½	⅝	0.372	Blunt.	5 "	"
4.	5½	⅝	0.372	Blunt.	5 "	"
5.	6	⅝	0.372	Sharp.	5 "	"
6.	5½	15/32	0.352	Sharp.	5 "	"
7.	5½	15/32	0.352	Chisel.	5 "	"
8.	6	⅝	0.372	Blunt.	5 "	"
9.	5½	9/16	0.316	Blunt.	5 "	"
10.	5½	9/16	0.316	Sharp.	5 "	"
11.	5½	9/16	0.316	Chisel.	5 "	"
12.	5½	9/16	0.316	Sharp.	5 "	"
13.	5½	9/16	0.316	Chisel.	5 "	"
14.	6	⅝	0.372	Chisel.	5 "	"

A study of the results to determine: (A) Comparative holding power in untreated ties; (B) Comparative holding power in treated ties; (C) Comparative holding power of the same timber, treated and untreated; (D) Effect of preservatives on holding power; (E) Relation between cross section of the spike and holding power; (F) Relation between depth of penetration and holding power; (G) Effect of the point of the spike on holding power; (H) Effect upon holding power of re-driving the spike, follows in detail:

A—Comparative Holding Power in Untreated Ties.

Table III. shows the average holding power of different untreated ties.

TABLE III.—*Average Holding Power in Untreated Ties.*

Kind of tie.	No. of Tests.	No. of Spks.	Resistance in lbs. for a pull of ⅛-in.	Resistance in lbs. for a pull of ¼-in.	Maximum resistance. Lbs.	Maximum resistance. Distance pulled.	Resistance in per cent. of that of white oak. Inch ⅛th.	Resistance in per cent. of that of white oak. Inch ¼ th.	Resistance in per cent. of that of white oak. Maximum.
White oak ..	10	30	3,510	3,950	7,870	5/16-in.	100	100	100
Elm	11	33	2,310	5,390	7,290	⅜-in.	66	136	93
Beech	3	9	2,240	3,790	8,180	⅝-in.	64	96	104
Chestnut	4	12	2,990	4,070	5,190	3/16-in.	86	103	66
Loblolly pine .	2	6	2,920	3,190	3,630	3/16-in.	85	81	46

This shows the comparative holding power of five kinds of timber. The last three columns show the holding power in terms of that of white oak. It is thought that a pull of ¼ in. gives results which are of more value in comparing the holding power of the different kinds of ties than the results for either greater or less distances, since the results for the ¼-in. pull represent the resistances of the various timbers to the withdrawal of the spike for a distance which should not be exceeded in practice, and since the maximum resistance and the results for a pull of ⅛ in. represent the resistances for distances which are therefore not of so much consequence as the ¼-in. pull. It is noticeable that with chestnut and loblolly pine the maximum resistance occurs at 3/16 in., which is a reason for comparing their maximum resistance with that of white oak at ¼ in. instead of with its maximum resistance as in the table. If this is done, the efficiencies of chestnut and loblolly pine for a ¼-in. pull or less are 131 and 85 per cent., respectively.

The fact that the maximum resistance did not occur until the spike had been pulled from 3/16 to ⅜ in. is interesting. While the spike is being driven the fibers of the wood are bent downward and are pressed outward, and as the spike is withdrawn the friction between the spike and the wood tends to draw the fibers into their original position, which causes them to crowd laterally against the spike and also toward the surface of the tie, until finally the external pull exceeds the internal resistance and the spike slips. When the fiber structure is open, there is considerable cellular space for the displaced fibers to occupy, and therefore the maximum resistance is low, and is quickly attained; but when the fiber structure is compact, the reverse is true. As the loblolly pine ties should always be preserved, the results for this timber are of doubtful value. For the best results elm ties also should be treated; but as some species of elm do not absolutely require treatment, elm is properly included. Arranging these timbers in the descending order of their resistances for a ¼-in. pull, we have elm, chestnut, white oak, beech and loblolly pine. The maximum holding power for the first three timbers in Table III. is satisfactory, but that for the last two is quite low. The last fact indicates that when timber of the softer varieties or timber having loose fiber structure is used for ties, some more efficient form of fastening should be devised.

B—Comparative Holding Power in Treated Ties.

Table IV. shows the average holding power obtained with various treated ties. The average results obtained with untreated white oak are also included so that comparisons can be made. The average for the resistances for all of the treated timbers is shown at the foot of the table. Excluding the last two timbers, the average resistance for the ¼-in. pull is 5,690 lbs. The maximum resistance of the last two timbers should be averaged with the resistances of the others for the ¼-in. pull, in which case the average resistance for all of the timbers for a ¼-in. pull or less is 5,400 lbs.

TABLE IV.—*Average Holding Power in Treated Ties.*

Kind of tie.	No. of Tests.	No. of Spks.	Resistance in lbs. for a pull of ⅛-in.	Resistance in lbs. for a pull of ¼-in.	Maximum resistance. Lbs.	Maximum resistance. Distance pulled.	Resistance in per cent. of that of white oak. Inch ⅛th.	Resistance in per cent. of that of white oak. Inch ¼ th.	Resistance in per cent. of that of white oak. Maximum.
White oak* ..	10	30	3,510	3,950	7,870	5/16-in.	100	100	100
Water oak ...	16	48	2,870	5,730	6,780	5/16-in.	82	145	86
Black oak ...	13	39	2,910	5,890	7,230	5/16-in.	83	149	92
Red oak	20	60	2,950	5,350	7,730	5/16-in.	84	135	98
Burr oak	3	9	2,670	5,750	9,210	⅝-in.	76	145	117
Ash	2	6	3,570	5,200	7,730	5/16-in.	101	131	98
Elm	5	15	2,590	5,940	7,500	5/16-in.	74	150	96
Beech	3	9	2,950	6,190	8,900	⅝-in.	84	157	113
Poplar	4	12	2,830	5,290	5,670	5/16-in.	81	134	72
Loblolly pine.	4	12	2,920	3,780	4,310	¼-in.	83	109	55
Sweet gum ..	5	15	3,230	5,320	5,300	5/16-in.	92	96	67
Average . ..	..	..	2,950	5,320	7,040	.....	84	135	89

*Untreated.

The resistances of the several timbers do not differ widely and the soft timbers give results which compare favorably with those obtained for the hard woods. This table also shows that the range for the maximum resistances is much greater than that for either the ⅛-in. or the ¼-in. pull. The resistances for the different species of oak are very nearly the same, the mean for a ⅛-in. pull being 2,850 lbs., for a ¼-in. pull 5,680 lbs. and for the maximum 7,740 lbs. With nearly all of the timbers the maximum resistance was obtained after the spike was pulled more than ¼ in., but there is no apparent relation between the amount of holding power and the distance through which the spike has been pulled. Comparing the resistances of treated timbers with that of untreated white oak, we see that the initial resistance of the white oak is higher than any of the other woods except one; while on the other hand, the resistance at ¼ in. in white oak is less than in any of the other woods save one. The maximum resistances of all but the last three timbers are practically the same. Considering the uniformity of the results obtained with a pull of ¼ in. in the few timbers which were available, there appears to be no strong reason for much discrimination between the different treated timbers.

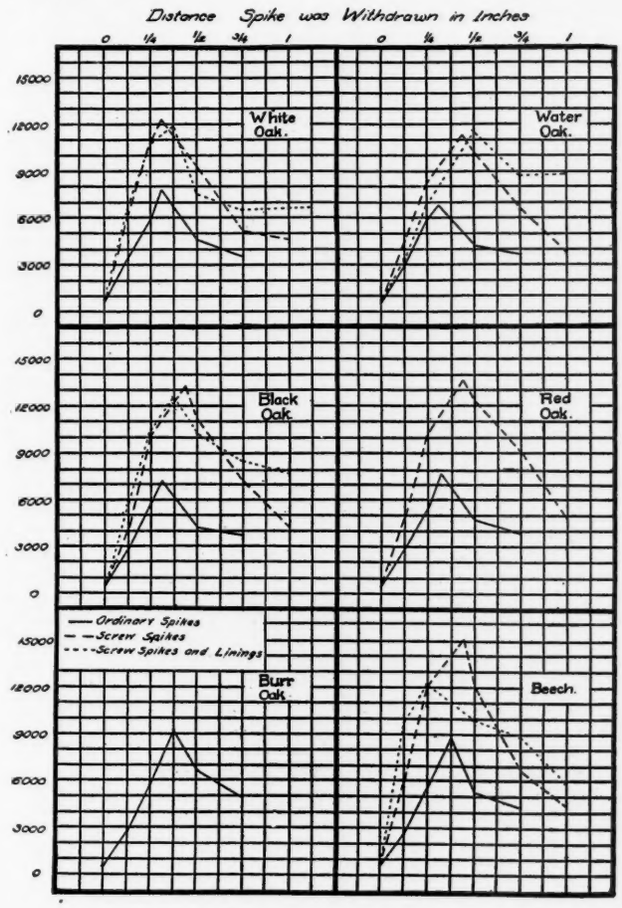
C—Comparative Holding Power of the Same Timber, Treated and Untreated.

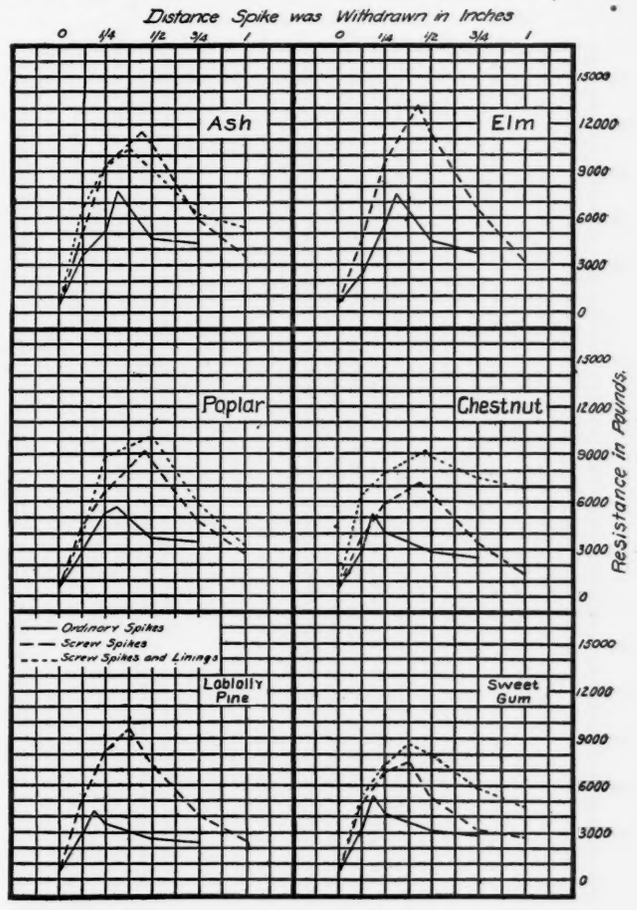
Table V. is given for the purpose of studying the effect of treatment on the holding power of a timber.

TABLE V.—*Relative Holding Power in Treated and Untreated Ties.*

Kind of tie.	No. of Ties.	No. of Spikes.	Condition of tie.	Resistance and gain in pounds due to treatment: ⅛-in. pull.	Gain.	¼-in. pull.	Gain.	Max. resistance.	Gain.
Elm	3	27	Untreated.	2,310	...	5,390	...	7,290	...
Elm	2	15	Treated.	2,590	280	5,940	550	7,500	210
Beech	1	9	Untreated.	2,240	...	3,790	...	8,180	...
Beech	1	9	Treated.	2,950	710	6,190	2400	8,900	820
Loblolly pine	1	6	Untreated.	2,920	...	3,190	...	3,630	...
Loblolly pine.	2	12	Treated.	2,920	000	3,730	640	4,310	680
Red oak	3	15	Untreated.	.....	...	.....	...	6,460	...
Red oak	4	21	Treated.	.....	...	.....	...	7,730	1270

This shows that higher resistances are developed in treated than in untreated ties. The average increase due to treatment for a ⅛-in. pull was 330 lbs.; for a ¼-in. pull, excluding the seemingly unreasonable increase in beech, 685 lbs., and for the maximum resistance 747 lbs. Considerable reliance is placed upon these conclusions, inasmuch as the methods of making the tests were exactly the same for the treated and untreated ties, and since the same





Figs. 1 and 2—Diagrams of Resistance to Withdrawal of Different Kinds of Spikes in Different Kinds of Wood.

number of spikes, 57, was used in both cases, and also since the preserved ties were treated by different processes and at different plants.

The increased resistance due to treatment has two causes: (1) The presence of the preservative in the cells, thus reducing the space into which the fibers can crowd as the spike is withdrawn; and (2) the hardening of the fibers by the steaming, preparatory to treatment, which renders them less pliable. The movement which took place among the fibers near the surface of the tie is interesting. In the untreated ties there was a crumpling of the fibers close to the spike, while the fibers in the treated ties were torn out in deep slivers extending from the spike to the blocks which supported the tie.

D—Effect of Preservatives on Holding Power.

Three distinct kinds of preserving solutions were used in the ties tested—creosote, zinc-creosote and zinc-tannin.

Table VI. is given to show the effect produced by the treating solution on the holding power of the tie. It does not show any marked difference between resistances in ties treated with the different preservative solutions. For example, the maximum resistance of the red oak is lower when treated with zinc-tannin than when treated with zinc-creosote, but the reverse is true of the initial resistance of the red oak and also of the maximum resistance of black oak. With elm the initial resistance is higher in creosoted ties than in those treated with zinc-creosote, but the maximum resistance is lower. If any rating were made in order of efficiency, it would appear about as follows: (1) creosote, (2) zinc-creosote and (3) zinc-tannin. However, there are too many uncertain quantities involved to make such a rating reliable; and, moreover, the effect of the treating solution on the holding power is only one of the many elements which must be considered when choosing between the different treating solutions.

E—Relation between the Cross Section of the Spike and the Holding Power.

The question to be answered here is, which size of spike will develop the highest holding power. To answer this question, Table VII. showing the relation between the cross section and the holding power has been compiled. From a study of these results it will be noticed that no general rating can be made for the various sized spikes in order of the resistances developed, since the spike which develops the lowest holding power for the ⅛-in. or the ¼-in. pull seldom develops the highest maximum resistance. For example, in white oak, the $\frac{19}{32}$-in. spike developed the highest resistance for the ⅛-in. pull, but the $\frac{9}{16}$-in. spike developed the highest resistance for the ¼-in. pull, and also the highest maximum resistance. In black oak the highest resistance for the ⅛-in. pull was developed by the $\frac{9}{16}$-in. spike, but that for the ¼-in. pull was developed by the $\frac{19}{32}$-in. size and the maximum resistance by the ⅝-in. spike. Averaging all of the resistances for the ⅛-in. pull, the ¼-in. pull and the maximum resistance collectively, we see that the average

TABLE VI.—*Effect of Different Preservatives on the Holding Power.*

Kind of tie.	Tie No.	Preservative.	Resistance in pounds for pull of ⅛-in.	¼-in.	Max. resistance, lbs.
Comparison of Zinc-tannin and Creosote.					
Water oak	4, 5, 25, 26, 29	Zinc-tannin,	2,380	5,010	6,260
	34	Creosote.	3,020	6,270	7,310
Red oak	6, 9, 22, 28, 30	Zinc-tannin.	3,170	5,470	6,580
	41	Creosote.	3,120	5,800	6,920
Comparison of Zinc-Creosote and Creosote.					
Red oak	7, 8	Zinc-creosote.	2,350	4,940	8,500
	41	Creosote.	3,120	5,800	6,920
Elm.	10	Zinc-creosote.	2,520	5,870	7,690
	37	Creosote.	2,600	6,350	7,210
Comparison of Zinc-tannin and Zinc-creosote.					
Red oak	6, 7, 8, 9, 22	Zinc-creosote.	2,350	4,940	8,500
	28, 30	Zinc-tannin.	3,170	5,470	6,580
Black oak	16, 18	Zinc-creosote.	2,850	5,620	7,040
	23, 24, 27	Zinc-tannin.	2,830	5,620	7,550

holding power of the $\frac{9}{16}$-in. spike is 4,990 lbs. for the $\frac{19}{32}$-in. spike 5,420 lbs. and for the $\frac{5}{8}$-in. spike 5,290 lbs. Because of the large number of spikes tested, seventy-two $\frac{9}{16}$-in., thirty-six $\frac{19}{32}$-in., and one hundred and two $\frac{5}{8}$-in., and the irregularity of the results, it was decided that no conclusions could be drawn from this table as to the relative holding power of the different sizes of spikes. However, the thickness of the spikes varied by only $\frac{1}{16}$-in. or about 10 per cent., and their areas by only 0.075 of a sq. in. or about 20 per cent.

TABLE VII.—*Relation Between the Cross-Section of the Spike and Its Holding Power.*

Kind of tie.	No. of Ties.	No. of Spikes.	Condition of tie.	Size of spike, inch.	Resistance to withdrawal, lbs. ⅛-in. pull.	¼-in. pull.	Max. resistance.
White oak	2	9	Seasoned	9/16	3,110	6,280	8,760
	2	6		19/32	3,750	6,380	7,620
	3	15		5/8	3,650	6,030	7,620
Black oak	4	15	Treated	9/16	2,910	5,340	6,530
	2	6		19/32	2,650	6,130	7,130
	4	18		5/8	2,550	5,710	7,240
Water oak	5	15	Treated	9/16	2,960	5,560	6,670
	6	18		19/32	2,970	5,310	6,010
	5	15		5/8	2,650	5,360	6,730
Red oak	7	21	Treated	9/16	2,300	4,760	7,650
	9	36		5/8	3,260	5,990	6,780
Beech	1	3	Seasoned	9/16	1,880	3,900	9,410
	1	3		19/32	2,550	5,400	7,660
	1	3		5/8	2,290	5,070	7,900
Beech	1	3	Treated	9/16	2,480	5,490	9,410
	1	3		19/32	3,530	6,990	8,250
	1	3		5/8	2,850	6,090	9,040
Sweet gum	1	6	Treated	9/16	2,190	3,770	4,610
	1	12		5/8	3,490	4,450	5,460

To test still further the relationship between the size of the spike and the holding power, a series of experiments was made with plain square rods with the results shown in Table VIII. Each result is the mean of 15 tests in a single kind of timber.

TABLE VIII.—*Experiments with Plain Square Rods in Beech Timber.*

Size of rod.		Area, sq. in.	Av. max. results, lbs.	Increase for each increment: Area, Sq. in.	Area, Per cent.	Resistance, Lbs.	Resistance, Per cent.
Successive increments in the size of the rod = ⅛-in.							
½-in.	square	0.250	6,280	.....	..	.....	..
⅝-in.	"	0.391	6,970	0.141	53	690	11
¾-in.	"	0.562	9,070	0.171	44	2,600	37
⅞-in.	"	0.765	9,380	0.203	35	310	3
Successive increments in the size of the rod = 1/16-in.							
9/16-in.	square	0.250	6,280	.....	..	.....	..
5/8-in.	"	0.316	6,450	0.066	25	170	3
11/16-in.	"	0.391	6,970	0.075	23	520	8

It will be seen from these results that there is an irregular increase in the holding power as the size of the rod is increased. Notice that with increments of ⅛-in., the successive increments in the resistance are at first large, but with the last rod this increment suddenly falls to practically nothing. This drop in the increment is principally due to the tendency of the large rod to split the tie. The results with $\frac{1}{16}$-in. increments do not differ materially from those in the first part of the table. The deduction is that holding power will be increased as the size of the rod is increased, but that it is not expedient to use rods (or spikes) larger than ¾ in. unless holes are bored for them.

F—Relation between the Depth of Penetration and Holding Power.

A series of experiments was made to determine the relation between the depth of penetration and the holding power. The results are given in Table IX.

TABLE IX.—*Holding Power in a White Oak Tie with Varying Depths of Penetration.*

Depth of penetration.	Resistance, lbs. Test No. 1.	2.	3.	4.	5.	Average.
½-in.	150	150	140	160	170	150
1-in.	480	.....	500	510	490	500
1½-in.	1,440	1,000	1,760	1,320	950	1,290
2-in.	2,250	2,250	2,050	2,900	2,760	2,450
2½-in.	3,430	3,840	3,050	2,940	3,570	3,360
3-in.	3,710	3,800	4,200	4,220	4,810	4,210
3½-in.	4,760	5,980	4,210	4,500	5,860	5,060
4-in.	5,950	7,190	6,310	5,850	6,080	6,270
4½-in.	7,510	7,510	7,720	7,340	.....	7,520
5-in.	8,380	9,070	8,540	7,790	7,900	8,340

The spikes had a taper point approximately 1 in. long. Fig. 3 shows that the holding power varies directly with the penetration, not counting the taper point. It is impracticable to use a spike longer than 5½ in. in a 6-in. tie, since a longer spike would either pass entirely through the tie or sliver it on the under side. In either case the fiber adjacent to the spike would quickly decay owing to the access of water. In a thicker tie, however, a longer spike could be used advantageously. The main precaution is to keep the spike from damaging the under surface of the tie, otherwise the longer the spike the greater the holding power.

G—Effect of the Point of the Spike on the Holding Power.

There were three distinct types of points on the spikes: blunt-point, chisel-point and bevel-point, as shown in Fig. 4.

The average results obtained with spikes having these types of points are shown in Table X. The average and relative resistances of each type of spike for all timbers are shown at the foot of the table. These averages show that both the blunt-pointed and the bevel-pointed spike are higher in holding power than the chisel-pointed spike. Since the average resistances of the blunt and the bevel-pointed spikes are practically the same, and since the blunt-pointed spike develops the highest resistance for the ⅛-in. and the ¼-in. pull the greatest number of times, the blunt-pointed spike is first in point of efficiency, although the bevel-pointed spike is a close competitor under all conditions. The chisel-pointed spike is last.

The two upper figures of Fig. 5 are the two halves of a red-oak tie showing the position of the fibers adjacent to the spike; and the lower figure is a portion of the other end of the same tie split after the spikes had been pulled out. The photograph was taken immediately after the tie had been split. The figures are too small to show details clearly, but an examination of the tie showed that the blunt-pointed spike disturbed more fiber than either the chisel or the bevel-pointed spikes, the last two disturbing about the same amount. The examination also showed that the blunt-pointed spike tore rather than cut the fibers, and deposited them in unequal bundles along its faces, while the chisel-pointed spike cut the fibers and deposited them quite uniformly both across and in front of each face. The bevel-pointed spike forced a majority of the fibers to the front face and toward the corners. The relatively high holding power of both the blunt and the bevel-pointed spikes is due to this unequal concentration of the fibers.

TABLE X.—*Effect of the Form of the Point, of the Spike on the Holding Power.*

Kind of tie.	No. of spikes.	Type of point.	Resistance in lbs. for ⅛-in pull. Lbs.	Rel-ative.	¼-in. pull. Lbs.	Rel-ative.	Maximum resistance. Lbs.	Rel-ative.
Water oak	33	Chisel.	2,780	100	5,250	100	6,540	100
Water oak	15	Bevel.	3,050	110	5,440	98	6,330	97
Black oak	9	Blunt.	3,020	106	6,890	121	8,280	119
" "	18	Chisel.	2,850	100	5,690	100	6,930	100
" "	12	Bevel.	2,680	91	5,560	98	6,800	98
Red oak	18	Blunt.	2,220	77	4,400	82	5,760	76
" "	21	Chisel.	2,880	100	5,350	100	7,630	100
" "	21	Bevel.	3,100	107	5,580	104	7,370	97
White oak	10	Blunt.	4,080	117	7,040	135	8,760	123
" "	12	Chisel.	3,490	100	5,190	100	7,090	100
" "	6	Bevel.	2,990	86	5,610	108	8,010	113
Elm	21	Chisel.	2,150	100	5,240	100	7,710	100
"	21	Bevel.	2,500	116	5,740	109	7,050	92
Beech	6	Blunt.	2,180	85	4,670	84	9,250	109
"	6	Chisel.	2,570	100	5,580	100	8,470	100
"	6	Bevel.	3,040	118	6,190	111	7,900	93
Chestnut	3	Blunt.	2,850	114	4,950	162	5,690	127
"	3	Chisel.	2,490	100	3,060	100	4,470	100
"	6	Bevel.	3,320	133	4,130	135	5,310	119
Loblolly pine	3	Blunt.	2,860	84	3,650	118	4,020	97
" "	6	Chisel.	3,420	100	3,390	100	4,120	100
" "	9	Bevel.	2,800	82	5,010	148	5,520	134
Av'g for all timbers		Blunt.	2,870	101	5,340	112	6,960	105
		Chisel.	2,840	100	4,810	100	6,610	100
		Bevel.	2,930	103	5,490	114	6,800	103

H—Effect on Holding Power of Re-driving the Spike.

In practice, when the spike is pulled out of the tie a moderate distance, it is driven back, provided the hole is not greatly enlarged. If the hole is much enlarged the spike is driven at another point. This constant re-spiking rapidly ruins the tie. A series of tests was made to determine the effect upon the holding power of re-driving the spike. The average maximum holding power of the re-driven spikes is shown in Table XI. along with the original

TABLE XI.—*Relative Holding Power of Newly-driven and Re-driven Spikes.*

Kind of tie.	No. of spikes.	Av. max. resistance, lbs. Original.	After re-driving.	Per cent. of origina..
Ash	6	8,640	6,490	75
Water oak	6	8,020	5,760	72
Red oak	6	8,030	5,230	65
Elm	6	7,910	4,840	61
Poplar	6	4,920	3,980	81
Sweet gum	6	5,040	4,150	82

maximum holding power of the same spike. It will be seen that the holding power of the re-driven spike is much less than that of the newly-driven spike. The resistance is affected so much in some woods as to make the practice of re-driving the spike a questionable procedure if the holding power alone is considered; but as the practice of re-driving the spike helps to lengthen the life of the tie, the practice cannot be justly condemned so long as the holding power is not excessively reduced.

HOLDING POWER OF SCREW SPIKES WITHOUT LININGS.

A series of tests was made to determine the holding power of screw spikes. The tests were conducted in the same manner as those with the ordinary spikes. The screw spikes were received from the following companies: No. 1 from the Illinois Central; No. 2 from the American Iron and Steel Manufacturing Company, Scranton; No. 3 from the South Side Elevated, Chicago; No. 4 from the Oliver Steel & Iron Company, Pittsburg, and No. 5 from the Pennsylvania Lines West.

A description of the different spikes is given in Table XII.

TABLE XII.—*Description of Screw Spikes.*

Spike No.	Length.	Diameter of core.	Projection of thread.	Pitch.	Depth of insertion.	Diam. of bored hole.
1.	5 in.	21/32-in.	3/16-in.	½-in.	4½ in.	11/16-in.
2.	5 in.	11/16-in.	⅛-in.	½-in.	4½ in.	11/16-in.
3.	5¼ in.	11/16-in.	⅛-in.	½-in.	4¾ in.	11/16-in.
4.	5½ in.	11/16-in.	⅛-in.	½-in.	5 in.	11/16-in.
5.	5 in.	21/32-in.	3/16-in.	½-in.	4½ in.	11/16-in.

The shank or threaded portion of the spike was usually ⅞ in. in diameter, and approximately 1 in. of the upper portion of the core tapered from the diameter of the core to that of the shank. The hole bored for the spike was not reamed, and the result was a

tight fit between the wood and the spike. This tight contact is gained in practice by the head of the spike bearing against the base of the rail. The spike was driven by means of a wrench, the thread cutting its own path. The number of screw spikes obtainable was not sufficient to make as long a series of tests as with the ordinary spikes.

A study of the results with this spike has been made to determine: (A) Relation between the depth of penetration and the holding power; (B) Relation between the holding power of the screw and of the ordinary spikes, and (C) Influence of certain details of the screw spike upon its holding power.

The average results of the tests with screw spikes are shown in Figs. 1 and 2.

A—Relation between Depth of Penetration and the Holding Power.

A series of tests was made to determine the relation between depth of penetration and holding power of the screw spikes. The experiments consisted of pulling spikes driven to depths of 1, 2, 3, 4 and 5 in. into a beech tie, three spikes being used for each depth. The numerical results are shown in Table XIII., and their averages are shown graphically in Fig. 6 together with some additional matter which is shown for the sake of comparison.

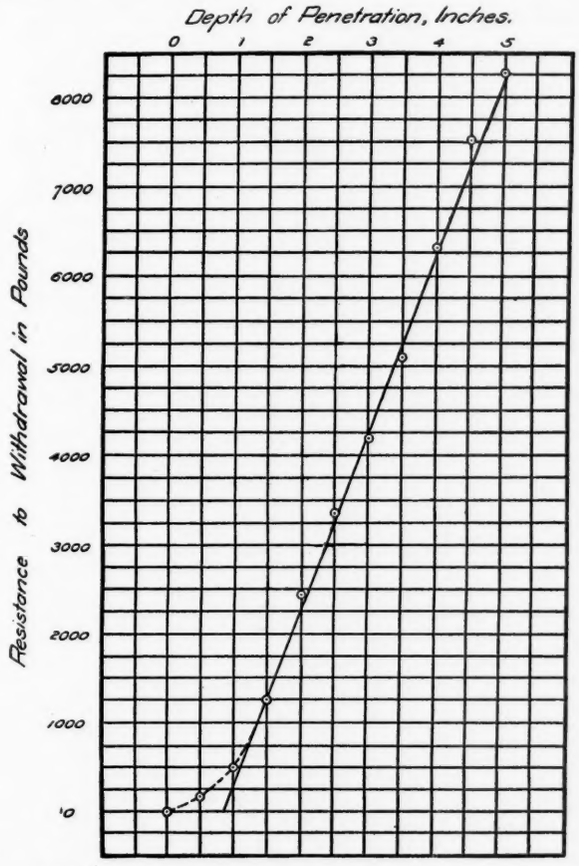


Fig. 3—Diagram of Resistance to Withdrawal of Ordinary Spikes for Various Depths of Penetration.

TABLE XIII.—*Results Obtained from Experiments on Depth of Penetration.*

	Resistance in pounds for penetration of—				
	1 in.	2 in.	3 in.	4 in.	5 in.
Test No. 1.....	2,770	4,560	9,610	13,100	17,360
" " 2.....	2,760	6,000	10,000	14,330	17,500
" " 3.....	2,790	4,940	8,490	13,330	16,840
Average	2,770	5,170	9,360	13,590	17,230

The results in Fig. 6 can be quite closely represented by two intersecting straight lines. The probabilities are that the actual resistances would be more nearly represented if the two straight lines were joined by a short curve near their intersection. Only the upper portion of the diagram is of interest, since penetrations of less than four inches should never be used, at least on heavy traffic railroads, the only roads likely to use screw spikes. The diagram shows that the resistance varies directly with the depth of penetration.

B—Relative Holding Power of Screw Spikes and Ordinary Spikes.

Table XIV. has been prepared to determine the relation between the holding power of the screw spike and that of the ordinary spike. As previously stated, the ordinary spikes were driven into the tie to a uniform depth of 5 in., while the screw spikes, being of different lengths, necessarily were inserted to unequal depths. On account of the relation existing between the depth of penetration and the holding power, the resistance for the screw spikes is based upon a penetration of 5 inches.

TABLE XIV.—*Relative Holding Power of the Screw Spike and of the Ordinary Spike in Several Timbers.*

Kind of tie.	Kind of spike.	Resistance in lbs. for ⅛-in. pull.	Resistance in lbs. for ¼-in. pull.	Resistance in lbs. for Max. resist.	Relative resistances ⅛-in. pull.	Relative resistances ¼-in. pull.	Relative resistances Max. resist.
Water oak	Ordinary.	2,870	5,730	6,780	100	100	100
Water oak	Screw.	4,888	9,180	12,190	170	160	179
Black oak	Ordinary.	2,910	5,890	7,230	100	100	100
Black oak	Screw.	4,760	10,420	14,110	164	177	203
Red oak	Ordinary.	2,950	5,350	7,730	100	100	100
Red oak	Screw.	4,900	10,400	13,560	166	194	176
White oak	Ordinary.	3,510	5,950	7,870	100	100	100
White oak	Screw.	6,250	11,900	12,630	178	200	188
Ash	Ordinary.	3,570	5,200	7,730	100	100	100
Ash	Screw.	5,700	10,470	12,760	162	200	165
Beech	Ordinary.	2,600	5,490	8,840	100	100	100
Beech	Screw.	6,450	13,140	16,230	248	221	238
Elm	Ordinary.	2,380	5,580	7,500	100	100	100
Elm	Screw.	5,120	10,090	13,690	215	181	183
Poplar	Ordinary.	2,830	5,290	5,670	100	100	100
Poplar	Screw.	3,880	6,210	7,490	137	117	132
Chestnut	Ordinary.	2,850	4,070	5,200	100	100	100
Chestnut	Screw.	3,690	6,340	8,700	129	155	167
Loblolly pine. .	Ordinary.	2,920	3,500	4,300	100	100	100
Sweet gum ...	Screw.	5,430	7,710	8,280	167	162	156
Sweet gum. ...	Ordinary.	3,230	4,120	5,300	100	100	100
Loblolly pine. .	Screw.	5,750	9,050	10,620	197	258	247

From Table XIV. it will be seen that the holding power of the screw spike is always greater than that of the ordinary spike, and that the relation between the two varies in the several timbers. For a pull of ¼ in. in the hard woods the holding power of the screw spike is from 167 to 221 per cent. of that of the ordinary spike, and in the soft woods the range is from 117 to 258 per cent.; or the average gain in the hard woods is 76 per cent., and in the soft woods 98 per cent. It is interesting to note that the resistances in the several timbers for the ⅛-in. pull with the screw spike are in eight out of eleven instances nearly the same as, or greater than, the resistances for the ¼-in. pull with the ordinary spike. This signifies that the screw spike is about twice as efficient as the ordinary spike for a pull of ¼ in. or less. The curves in Figs. 1 and 2 show graphically the relative efficiency of the two forms of spikes with some information to be referred to later.

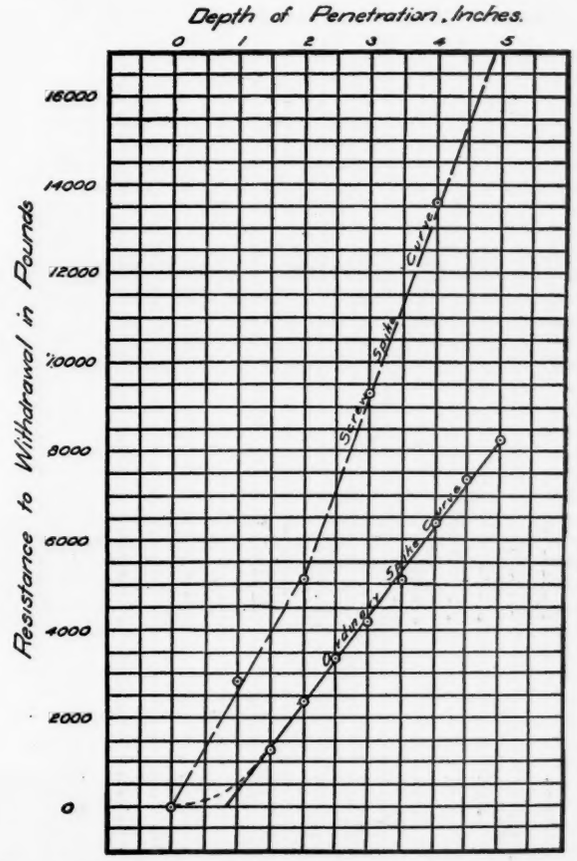


Fig. 6—Diagram of Resistance to Withdrawal of Screw Spikes and Ordinary Spikes for Various Depths of Penetration.

C—Effect of Details of the Screw Spike on Its Holding Power.

In countries where the screw spike is extensively used it has been perfected in detail until it nearly fulfills the requirements of practice. In North America the screw spike will probably be the

successor to the ordinary spike, and it may again be necessary to adjust the details to suit local conditions. Therefore, a few observations on the relation of some of the details of this spike to its holding power come within the scope of this paper. The details to be discussed are the diameter of the core, the projection and pitch of the thread and the length of the thread.

The soft steel from which the screw spike is made has an ultimate strength of about 66,000 lbs. per sq. in., so that the tensile strength of a spike $\frac{11}{16}$ in. in diameter is approximately 24,000 lbs. The ultimate compressive resistance across the grain of well-seasoned white oak is about 4,000 lbs. per sq. in., and experiments demonstrate that the thread of the spike in compacting the wood

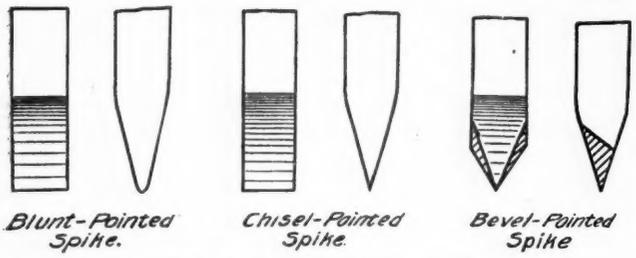


Fig. 4—Forms of Spike Points.

fibers increases the resistance about 40 per cent.* Therefore, taking 5,600 lbs. as the ultimate compressive strength of compacted white oak, and taking 17¾ in. and ⅛ in. respectively as the length and projection of the thread on the 5-in. spike, and making no allowance for frictional resistance between the core of the spike and the wood, the theoretical resistance would be

5,600 x 17¾ in. x ⅛-in. = 12,430 lbs.

The average actual resistance obtained in white oak ties as shown in Table XIV. is 12,630 lbs., which agrees closely with the theoretical resistance. The tensile strength of the screw spike is about 12,000 lbs. greater than the maximum resistance of white oak, which difference is greater than necessary and indicates an uneconomical use of metal in the spike. Since the ties tested are representative of

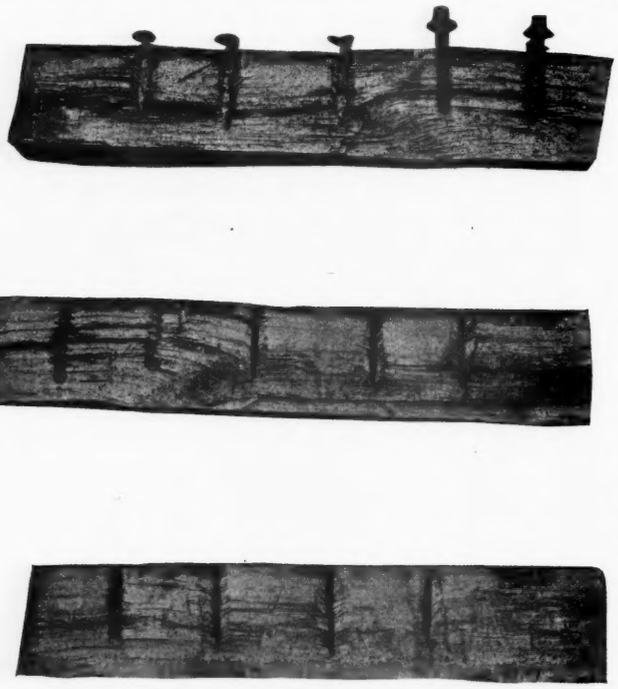


Fig. 5—Effect of Spikes in Displacing the Fibres of the Tie.

American practice, there is no apparent reason for not having the ultimate strength of the two materials in contact more nearly equal than at present, and by some slight change in the detail of the spike this could readily be accomplished. Three ways in which the ultimate strength of the materials may be made more nearly equal are: (1) increase in length of threaded portion; (2) increase in projection of thread, the length and the diameter of the core remaining the same; (3) increase in projection of thread at the expense of the core, the length remaining the same. The pitch is assumed to be ½ in. in all cases, since it has been found in practice that this pitch gives better results than either a greater or smaller pitch.*

*Bulletin No. 50, U. S. Department of Agriculture.

(1) The length of the thread on the 5-in. spike is 17¾ in. and the width is ⅛ in.; therefore, the bearing is 2.22 sq. in. If the spike is made 6 in. long two convolutions of the thread will be added, the bearing area will become 2.71 sq. in., and the holding power will be increased from 12,630 lbs. to 15,180 lbs. This leaves a difference of only 8,900 lbs. between the ultimate strength of the wood and that of the spike.

(2) If the length of the spike and the diameter of the core are not changed, and if the projection of the thread is increased $\frac{1}{16}$ in., the total resistance would amount to 15,510 lbs., leaving an ultimate strength of the spike only 8,500 lbs. greater than that of the wood.

(3) If the length of the threaded portion of the spike remains unchanged and if the projection of the thread is increased $\frac{1}{16}$ in. at the expense of the core, the maximum resistance would amount to 15,510 lbs., while the ultimate strength of the spike would be reduced to 20,200 lbs.

The diameter of the shank of the spike would have to be increased with some of the changes in the detail of the lower portion, and when the resistance to lateral displacement is taken into account, we see that this change also would be beneficial. The conclusion is that the screw spike in its present form is about twice as efficient as the ordinary spike; and that this efficiency could be increased by some slight change in the detail of the screw spike.

The following table shows the relative holding power of the ordinary spike, the screw spike, and the screw spike with helical lining in several timbers:

TABLE XV.—*Shows the Relative Holding Power of the Ordinary Spike, the Screw Spike, and the Screw Spike with Helical Lining in Several Timbers.*

Kind of tie.	Kind of spike.	Resistance in lbs. for ⅛-in. pull.	Resistance in lbs. for ¼-in. pull.	Resistance in lbs. for Max. resist.	Relative resistance. ⅛-in. pull.	Relative resistance. ¼-in. pull.	Relative resistance. Max. resist.
White oak	Ordinary.	3,510	5,950	7,870	100	100	100
" "	Screw.	6,250	11,900	12,630	178	200	188
" "	Lining.*	6,440	10,880	11,960	183	183	152
Water oak	Ordinary.	2,870	5,730	6,780	100	100	100
" "	Screw.	4,880	9,180	12,190	170	160	179
" "	Lining.*	3,190	6,780	11,580	111	118	171
Black oak	Ordinary.	2,910	5,890	7,230	100	100	100
" "	Screw.	4,760	10,420	14,110	164	177	203
" "	Lining.*	5,690	10,420	12,500	195	177	173
Ash	Ordinary.	3,570	5,200	7,730	100	100	100
"	Screw.	5,700	10,470	12,760	162	200	165
"	Lining.*	6,640	9,370	10,470	186	180	135
Beech.	Ordinary.	2,600	5,490	8,840	100	100	100
"	Screw.	6,450	13,140	16,230	248	221	238
"	Lining.*	9,720	10,860	12,150	373	198	138
Poplar	Ordinary.	2,830	5,290	5,670	100	100	100
"	Screw.	3,850	6,210	7,490	137	117	132
"	Lining.*	3,910	8,860	10,320	138	162	182
Chestnut	Ordinary.	2,850	4,070	5,200	100	100	100
"	Screw.	3,690	6,340	8,700	129	155	167
"	Lining.*	6,390	7,950	9,150	224	195	176
Sweet gum ...	Ordinary.	3,230	4,120	5,300	100	100	100
" " ...	Screw.	5,430	7,710	8,280	167	162	156
" " ...	Lining.*	5,030	7,260	8,690	136	176	164

*Screw spike with helical lining.

PART II.—RESISTANCE TO LATERAL DISPLACEMENT.

The railroad spike is subjected not only to a direct pull by the undulation of the rail, but also to a horizontal thrust due to the lateral movement of the rail. On roads having a large amount of curvature the lateral resistance is of more importance than that of direct pull. To determine the amount of the resistance to lateral displacement which is developed by various forms of spikes the writer made a series of tests in which the lateral thrust was produced by the blows of a heavy hammer. The hammer consisted of a cast-iron weight suspended by a wooden rod from the joists of the floor above. Fastened to the joists were metal strips upon which the knife edges of the rocking arm rested. These strips were 6 ft. long, and were notched along the entire upper edge to permit the placing of the rocking arm in different positions. The length of the suspending rod was 9 ft. The weight of the hammer was 100 lbs. and the distance through which it was allowed to fall was 1½ ft., so that the amount of the impact for each blow was 150 ft.-lbs. The hammer delivered its blow on the end of a tool-steel bar which projected beyond the end of the tie, the other end of the bar being shaped to fit under the head of the spike.

The spikes used in this series of tests were $\frac{5}{16}$ in. and ⅝ in. ordinary spikes and screw spikes. Each spike was subjected to five blows and the displacement produced by each blow was carefully measured. Usually four or five spikes of each kind were tested, but when there was much lack of uniformity in the results a larger number were tested. All of the spikes were bent to a curve, the central point of which was about 1½ in. below the surface of the tie. The ordinary spikes were pulled from the tie a short distance, but the thread of the screw spikes gripped the wood so as to prevent the spike from being pulled out even a perceptible amount.

LATERAL RESISTANCE OF ORDINARY SPIKES.

The average movement of ordinary spikes for each of the several blows is shown in Table XVI. The average total movement of the ⅝ in. spikes in the first seven timbers was 0.65 in., and that of the $\frac{5}{16}$ in. spikes was 0.75 in. In the last four timbers the average total movement of the ⅝ in. spikes was 0.74 in., and that of the

$\frac{9}{16}$ in. spikes was 0.94 in. The total deflection of the $\frac{9}{16}$ in. spikes was usually sufficient to allow a rail to clear the head of the spike if it were overturned. The corresponding movement of the ⅝ in. spikes was not usually sufficient to allow a like clearance, although it was considerably more than would be allowed in practice. The first blow is of more importance than the succeeding blows in testing the efficiency of a spike. While the distances through which the different sized spikes were deflected by the first blow differ but a small amount, this difference is sufficient to show that the deflection is less for the ⅝ in. spikes than for the $\frac{9}{16}$ in. These results, together with the fact that the ⅝ in. spikes were bent less by the impact than the $\frac{9}{16}$ in. spikes, indicate that the ⅝ in. spike is more efficient in resisting lateral displacement than the $\frac{9}{16}$ in. spike.

LATERAL RESISTANCE OF SCREW SPIKES.

The method of determining the lateral resistance of screw spikes was the same as that used for ordinary spikes. The screw spikes used were all practically alike except that they were of various lengths. In making the tests the spikes were used indiscriminately, but since they were not all ofy the same length some tests were made to determine the effect of impact upon spikes which were driven into the tie to different depths. The spikes used for the latter tests were all of the same make, and were cut to lengths of 3, 3½, 4, 4½ and 5 in., and were all driven into a single kind of timber. The results of these tests are shown in Table XVII. While the results for the 4- and 4½-in. spikes are the same, the averages in the last column of the table show that the amount of the lateral movement decreases as the depth of penetration increases. Also, the difference between the deflections of the 4, 4½ and 5-in. spikes is practically negligible, but for shorter lengths the difference in the deflections becomes greater. Table XVIII. gives the lateral movement of the screw spikes for each blow. The number of spikes used in each kind of timber was usually three; but in case there was considerable variation in the results, more spikes were tested.

TABLE XVI.—*Lateral Movement of Ordinary Spikes for Each Blow.*

Kind of tie.	Size of spike.	Movement for each of the several blows—1-in.	2-in.	3-in.	4-in.	5-in.	Average movement.
White oak	$\frac{9}{16}$ sq. in.	0.21	0.11	0.17	0.12	0.09	0.136-in.
White oak	⅝-sq. in.	0.17	0.14	0.11	0.09	0.08	0.118-in.
Water oak	$\frac{9}{16}$-sq. in.	0.19	0.18	0.17	0.11	0.11	0.152-in.
Water oak	⅝-sq. in.	0.17	0.13	0.13	0.10	0.08	0.122-in.
Black oak	$\frac{9}{16}$-sq. in.	0.21	0.16	0.17	0.11	0.06	0.142-in.
Black oak	⅝-sq. in.	0.17	0.16	0.12	0.08	0.09	0.124-in.
Red oak	$\frac{9}{16}$-sq. in.	0.21	0.15	0.14	0.11	0.13	0.148-in.
Red oak	⅝-sq. in.	0.14	0.14	0.11	0.14	0.08	0.122-in.
Ash	$\frac{9}{16}$-sq. in.	0.23	0.18	0.15	0.12	0.10	0.156-in.
Ash	⅝-sq. in.	0.18	0.15	0.14	0.16	0.10	0.146-in.
Elm	$\frac{9}{16}$-sq. in.	0.22	0.11	0.12	0.13	0.11	0.138-in.
Elm	⅝-sq. in.	0.21	0.14	0.13	0.11	0.11	0.140-in.
Beech	$\frac{9}{16}$-sq. in.	0.25	0.16	0.17	0.13	0.13	0.168-in.
Beech	⅝-sq. in.	0.14	0.11	0.10	0.10	0.10	0.110-in.
Poplar	$\frac{9}{16}$-sq. in.	0.27	0.14	0.15	0.14	0.12	0.164-in.
Poplar	⅝-sq. in.	0.16	0.18	0.09	0.10	0.11	0.128-in.
Chestnut	$\frac{9}{16}$-sq. in.	0.32	0.26	0.25	0.17	0.23	0.246-in.
Chestnut	⅝-sq. in.	0.22	0.19	0.20	0.18	0.14	0.186-in.
Sweet gum	$\frac{9}{16}$-sq. in.	0.28	0.21	0.17	0.15	0.15	0.192-in.
Sweet gum	⅝-sq. in.	0.16	0.18	0.13	0.12	0.12	0.142-in.
Loblolly pine	$\frac{9}{16}$-sq. in.	0.22	0.14	0.18	0.11	0.04	0.148-in.
Loblolly pine	⅝-sq. in.	0.18	0.12	0.13	0.13	0.09	0.128-in.

Table XIX. is given to facilitate comparison of the relative lateral resistance of ordinary and screw spikes. The data was collected from Tables XVI. and XVIII. The average total deflection of the screw spike in the first seven timbers is 0.50 in., which is 0.15 in. less than that of the ⅝-in. ordinary spike and 0.25 in. less than that of the $\frac{9}{16}$ in. ordinary spike. In the last four kinds of timber the average total deflection of the screw spike was 0.70 in., which is practically the same as that of the ⅝-in. ordinary spike, but which is 0.24 in. less than that of $\frac{5}{16}$-in. common spike. The results in the last two columns of Table XIX. show that the screw spike is superior to the $\frac{9}{16}$-in. ordinary spike in all but two kinds of timber, and that the screw spike has a higher efficiency than the ⅝-in. ordinary spike in all but three kinds of timber.

TABLE XVII.—*Relation Between the Depth of Penetration and the Resistance to Lateral Displacement.*

Depth of Insertion.	Deflection in inches—No. of blows.—1.	2.	3.	4.	5.	Av. for five blows.
3-in.	0.24	0.46	0.64	0.78	0.87	
	.22	.41	.55	.69	.84	
	.24	.43	.67	.76	.98	
Average	0.23	0.43	0.62	0.73	0.90	0.582
3½-in.	0.24	0.46	0.62	0.77	0.80	
	.24	.39	.53	.69	.80	
	.19	.34	.49	.63	.74	
Average	0.22	0.40	0.55	0.70	0.78	0.530
4-in.	0.20	0.39	0.49	0.60	0.71	
	.21	.40	.57	.63	.77	
	.23	.33	.57	.62	.72	
Average	0.21	0.37	0.54	0.62	0.73	0.494
4½-in.	0.24	0.30	0.50	0.65	0.74	
	.20	.34	.53	.68	.73	
	.22	.36	.54	.62	.79	
Average	0.22	0.33	0.52	0.65	0.75	0.494
5-in.	0.22	0.38	0.49	0.61	0.71	
	.23	.40	.55	.67	.75	
	.15	.34	.48	.57	.69	
Average	0.20	0.34	0.51	0.62	0.72	0.478

TABLE XVIII.—*Lateral Movement of the Screw Spike for Each Blow.*

Kind of tie.	Movement for each of the several blows—1.	2.	3.	4.	5.	Average movement.
White oak	0.09	0.08	0.05	0.07	0.10	0.078-in.
Black oak	0.11	0.08	0.06	0.07	0.09	0.082-in.
Water oak	0.09	0.07	0.08	0.10	0.09	0.086-in.
Red oak	0.13	0.08	0.13	0.12	0.08	0.108-in.
Ash	0.16	0.09	0.09	0.12	0.08	0.108-in.
Elm	0.17	0.16	0.13	0.15	0.09	0.140-in.
Beech	0.14	0.12	0.10	0.07	0.08	0.102-in.
Poplar	0.17	0.07	0.12	0.16	0.13	0.130-in.
Chestnut	0.16	0.10	0.11	0.10	0.09	0.132-in.
Sweet gum	0.24	0.16	0.10	0.14	0.10	0.148-in.
Loblolly pine	0.21	0.13	0.19	0.12	0.14	0.154-in.

The last two columns in Table XIX. show that the ordinary spike was usually displaced more than the screw spike by each blow. This should be expected since the common spike was smaller in cross section than the screw spike, and also since the latter had better bond with the wood. While the use of the screw spike is recommended to the American railroads, it is thought that the practice of Bavarian railroads could be followed to advantage. These roads have adopted the use of the screw spike on the gage side of the rail to resist overturning, but use two square spikes on the outside to resist lateral movement. This practice has been found to give very beneficial results. The figures in the last two columns show that the lateral resistance of two ordinary spikes is considerably more than that of one screw spike, and therefore if two spikes are considered as resisting the impact instead of one, the results will be in favor of the ordinary spikes. Not only is this true, but the first cost for spikes would be reduced, since the screw spike costs about 4 cents at the present time, whereas the ordinary spike costs much less. The maintenance cost of either form of spike is almost negligible.

TABLE XIX.—*Relative Lateral Displacement of Ordinary and Screw Spikes.*

Kind of tie.	Movement of ordinary spikes—$\frac{9}{16}$-in.	⅝-in.	Average movement of screw spike.	Average movement; ordinary spikes in terms of per cent. of movement of screw spike.—$\frac{9}{16}$-in.	⅝-in.
White oak	0.136	0.118	0.078-in.	175	152
Black oak	0.152	0.122	0.082-in.	186	149
Water oak	0.142	0.124	0.086-in.	165	145
Red oak	0.148	0.122	0.108-in.	137	115
Ash	0.156	0.146	0.108-in.	144	135
Elm	0.138	0.140	0.140-in.	99	100
Beech	0.168	0.110	0.102-in.	165	108
Poplar	0.164	0.128	0.130-in.	126	99
Chestnut	0.246	0.186	0.132-in.	186	141
Sweet gum	0.192	0.142	0.148-in.	129	96
Loblolly pine	0.148	0.128	0.154-in.	96	83

An item of interest which is properly beyond the limits of this article is that of the 90 screw spikes used in making these tests only two were broken. One was broken under a tension of 14,000 lbs., the break being caused by an incipient crack just under the head of the spike. The other spike broke under the fourth blow of the hammer, this break being due to uncombined graphite in the metal. As the spikes were obtained from different sources, and were of different manufacture, it is thought that the test was sufficiently severe to show that the screw spike, as manufactured at present, will successfully withstand the shocks of passing trains. As the spikes were used several time during the tests, the percentage of spikes broken is very low.

SUMMARY OF RESULTS.

(1) The maximum resistance to direct pull varies from 6,000 to 14,000 lbs. for screw spikes, from 3,000 to 8,000 lbs. for ordinary spikes when driven into untreated timbers, and from 4,000 to 9,000 lbs. for ordinary spikes when driven into treated timbers.

(2) The direct pull required to withdraw ordinary spikes ⅛-in. varies from 2,000 to 3,500 lbs. for untreated timbers, and from 2,500 to 3,500 lbs. for treated timbers.

(3) The direct pull required to withdraw ordinary spikes ¼-in. varies from 3,000 to 5,400 lbs. for untreated timbers and from 3,800 to 5,900 lbs. for treated timbers.

(4) Timbers having loose fiber structures have lower resistances to direct pull than timbers having compact fiber structures.

(5) The amount of withdrawal which must occur for ordinary spikes to develop the maximum resistance is less for soft woods than for hard woods.

(6) Spikes driven into treated timber offer a greater resistance to direct pull than spikes in untreated timbers, and the difference between this resistance for treated and untreated timbers is greater for soft woods than for hard woods.

(7) The difference in the resistance to direct pull for the different sized spikes in use ($\frac{9}{16}$ in., $\frac{12}{32}$ in. and ⅝ in.) is very small.

(8) The resistance of ordinary spikes to direct pull varies directly as the depth of penetration, neglecting the tapering point.

(9) Blunt-pointed and bevel-pointed spikes have a slightly greater resistance to direct pull than chisel-pointed spikes.

(10) For withdrawals less than ¼ in., ordinary spikes which are driven into bored holes have a little greater resistance to direct pull than spikes driven in the ordinary way.

(11) The resistance to direct pull for re-driven spikes is from

60 to 80 per cent. of the resistance of newly driven spikes.

(12) The efficiency of screw spikes to resist withdrawal is nearly twice as great as that of common spikes.

(13) The resistance of ⅝-in. spikes to lateral displacement is slightly greater than that of $\frac{9}{16}$-in. spikes.

(14) The resistance to lateral displacement increases with the depth of penetration, but the increase is negligible for depths of penetration greater than 4 in.

(15) Screw spikes are more efficient than ordinary spikes in resisting lateral displacement.

Loss and Damage to Freight.*

My experience as an adjuster of freight claims has thoroughly shown that a very large percentage of the claims made against carriers have real merit and deserve expeditious adjustment. It is also my experience that the average claimant is quite as ready to consider the carrier's side of any cases which appear in doubt as we are to view theirs and, notwithstanding that the claim agent generally meets shippers and consignees at a time when they are not feeling particularly friendly toward the road, if he is desirous of establishing a reputation for fair and courteous dealing it is possible for him to make many friends, improve the standard of his profession and make known to claimants the true policy of his company.

The most frequent criticism of claim departments is for their tardiness in making claim settlements, and these complaints are not only made by claimants, but by representatives of the traffic department who are interested in making the service as satisfactory to the shipper as possible.

Wisely and progressively managed, the freight claim department may become an important factor in securing and retaining traffic, but to accomplish this it must possess a thorough system, devoid of circumlocution, for promptly investigating all claims and complaints, and in particular for treating with claimants in a uniformly businesslike manner. While carefully guarding the carriers' rights and interests it should be liberal in its consideration of claimants, avoiding a narrow policy or insistence on technicalities where important principles are not involved.

Many claim officers are to-day so equipped that they can and do promptly settle all claims in which their road alone is interested. Their efforts, however, are not appreciated by their company or its patrons, for the sole reason that claims in which other carriers are involved are delayed indefinitely because of an ill-advised and unfair practice of giving preference to the claims originating with them, inefficiency of the claim agent or an indifferent claim policy.

It is true the average interline claim cannot be adjusted as expeditiously as those in which but one road or system is interested, but that months should be consumed in the investigation of claims involving several carriers should only be necessary in exceptional cases. Both the Freight Claim Association and committees composed of progressive claim officers, are giving consideration to interline claim settlements, and several plans have been suggested from which it is expected substantial improvements will result; yet those roads which are indifferent to the need of a thoroughly effective and business-like claim policy will, to a greater or less extent, impede the operation of any improvements in this direction until they are fully awakened to a sense of their obligations to other lines.

During the past 10 years the claims which carriers have been called upon to entertain for loss and damage to freight have increased far beyond the growth of traffic, making serious inroads upon the revenues and doubling the forces employed in claim offices and elsewhere. This condition can be traced to many causes, principal among which are: Acceptance of package freight without adequate marks to insure its safe carriage and delivery; acceptance of many classes of freight when not sufficiently protected to prevent injury from the ordinary handlings it must receive; acceptance of valuable dry goods, plated ware, liquors, boots and shoes, etc., in frail boxes fastened with a few wire nails, which invite stealing by dishonest truckmen and freight handlers; shipment of perishable freight when not in prime condition, or when weather conditions make safe and prompt deliveries doubtful.

These are a few of the causes for claims which shippers make possible through reasons of economy, or lack of regard for the safety of their goods and the interests of their consignees.

Frail and second-hand boxes of uncertain strength and without erasure of old marks are used for the shipment of goods of all values; fragile articles are shipped with hardly sufficient protection to insure safety in carting to the carrier, and for the loss or injury resulting from these practices we are held accountable. If objection is made before receipt, we are informed that other lines are ready to take the goods, and if we question claims which arise from improper conditioning of goods attention is directed to our obligations as common carriers.

In opening packages which have been delivered in apparently perfect condition the consignee discovers part of his order missing, or some fragile article broken. Does the claimant say probably this is due to a mistake or accident of shippers or to theft or carelessness of their truckmen? Generally he does not. He finds it much easier to place the responsibility on the carrier, who being unable to certify to quantity or condition of contents of packages finds the claim difficult to defend. What will correct these conditions is the earnest co-operation of shippers and receivers of freight with the transportation lines in careful marking of freight shipped in small quantities and the securing of merchandise packages so that their contents cannot be readily removed, or, at least, without leaving some evidence or indication of the loss.

As to losses and damages to freight for which transportation lines are wholly responsible, the causes are without number, but for the purpose of consideration here, we will divide them into two general classes, avoidable and unavoidable; avoidable when caused by carelessness or negligence of employees, and unavoidable when ordinary and reasonable care is exercised.

As is true in respect to many other great business enterprises where large forces are employed, the negligent acts of indifferent or incompetent employees result in both direct and indirect losses; direct when the company is called on to pay the claims, and indirect when traffic is diverted to other routes because of unsatisfactory service.

Whether the average railroad employee is less regardful of his company's interests than those of large industrial concerns, or whether the growing demand for labor has influenced employees to feel less concern in the affairs of those whom they serve, are questions I will not undertake to decide, but losses clearly chargeable to avoidable causes have, during the past few years, increased alarmingly. Perhaps this can be largely attributed to the enormous increase in traffic which often taxes cars, terminal and station facilities to their utmost, requiring constant pressure on those directly concerned, as well as hurried discharge of duties; but the conclusions reached after investigating causes for loss too often remind me of the old story of the car inspector, who, being asked why he was tapping the car wheels with his hammer, replied, "D—— if I know, but thems the orders."

Enough has been said to illustrate my principal point, the development of closer relationship and co-operation between the different interests involved which will aid in removing many causes for avoiding losses and damages to freight.

In regard to overcharges the following, which is quoted from the *American Railway Journal*, published in the year 1839, may be of interest as indicating the possible origin of that class of claims in this country:

> I hope in granting charters hereafter the legislature will look closely into the question of what provisions are necessary to guard the citizen from imposition. From Philadelphia to New York the fare is $5 per head. Fifteen passengers on an average make a ton, therefore the charge is equal to $75 a ton for 100 miles. According to report, the cost of transporting coals on the road for 100 miles is 53 cents a ton. Now deduct the cost of transporting a ton of coals from the cost of transporting a ton of passengers, and it will be seen that the railroad clearly gains. Possibly some allowance should be made for the difference between the cost of passenger cars and burden cars, but it cannot be much. I hope that in any new charters which may be granted the legislature will correct this error, as it is very material to travelers.

*An address by Robert L. Calkins, Freight Claim Agent of the New York Central & Hudson River Railroad, before the New York Traffic Club.

Foreign Railroad Notes.

The locomotive works of J. A. Maffei in Munich have built for the Bavarian State Railroads a locomotive capable of hauling a train weighing 165 tons at a speed of 93 miles an hour. This engine was tested July 1 and 2, and maintained for a prolonged time a speed of 96 miles an hour, which is declared to be the greatest speed ever made in Europe by a steam locomotive. It is a four-cylinder compound with 6-ft. drivers, Schmidt superheater and Westinghouse high-speed brakes.

Freight trains on the Prussian State Railroads have heretofore been limited to a prescribed number of "car axles," for the various grades, curves, etc. The Minister in charge has now ordered that three of the directories keep accurate records of the weights of cars and loads behind tenders during the month of July as data for prescribing tonnage instead of axles as the basis of the limits of trains.

The Italian State Railroads have declined to take over the steamboat service on the lakes of north Italy. This service is something like that on Lake George, N. Y., only much more important, as the country on these lakes is thickly peopled and very productive. On the other hand, they are to maintain steamer lines between Naples and Palermo, which is the quickest route to the larger part of Sicily, and another steamer line from Civita Vecchia, the port of Rome.

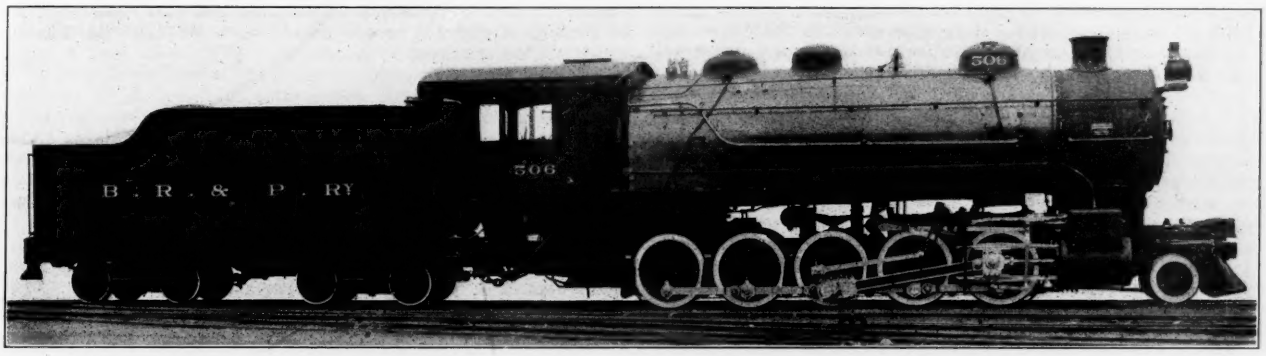
Decapod Locomotive for the Buffalo, Rochester & Pittsburg.

The American Locomotive Company has recently built six decapod (2-10-0) locomotives at the Brooks works for the Buffalo, Rochester & Pittsburg. These engines have been built for pusher service between Clarion Junction, Pa., and Freeman, 17 miles, with a grade of 58 ft. to the mile, which is the controlling grade on northbound traffic. In addition to the wheel arrangement which, though not novel, is by no means common, the engines are interesting for their great weight and high tractive power. They are the heaviest simple engines ever built by the company and have a total weight in working order of 268,000 lbs., of which 243,000 lbs. is on the driving wheels. The maximum tractive power is 55,350 lbs. Up to the present time trains on this grade, which has numerous curves up to 8 deg., are moved by two consolidation locomotives having a tractive power of 38,000 lbs. each. The rated train load for the two is 3,350 tons, with one engine at the rear pushing. The rating of the same class of power (one engine) from Punxsutawney, Ernest or Dubois to the foot of the grade is 3,500 tons. With the track improvements completed, that are now in hand, it is expected that these consolidation locomotives will be able to haul 4,000 tons to the foot of Clarion Hill grade from either Punxsutawney, Ernest or Du Bois, and the decapod engines have been built to handle a train of 4,000 tons up the grade with a consolidation in the lead.

With cylinders of the size used in these engines high steaming capacity is essential, and in this case the example of the Northern Pacific has been followed and the length of the tubes cut down to 15 ft. 6 in. by the introduction of a combustion chamber. About a year ago some engines of the Mikado type were designed for the Northern Pacific with combustion chambers 3 ft. long and tubes 16 ft. 9 in. long, which were 1 ft. 9 in. shorter than the tubes in similar engines without the combustion chamber. This caused a reduction in tube heating surface from 3,339 sq. ft. to 2,737 ft., and only increased the total firebox heating surface, including the arch tubes, from 189 sq. ft. to 242 sq. ft. Equating the tube heating surface to firebox heating surface of these Northern Pacific engines by the Vaughan formula, gives 965 sq. ft. of total equated heating surface for the engine without the combustion chamber and 911 sq. ft. for the engine with it.

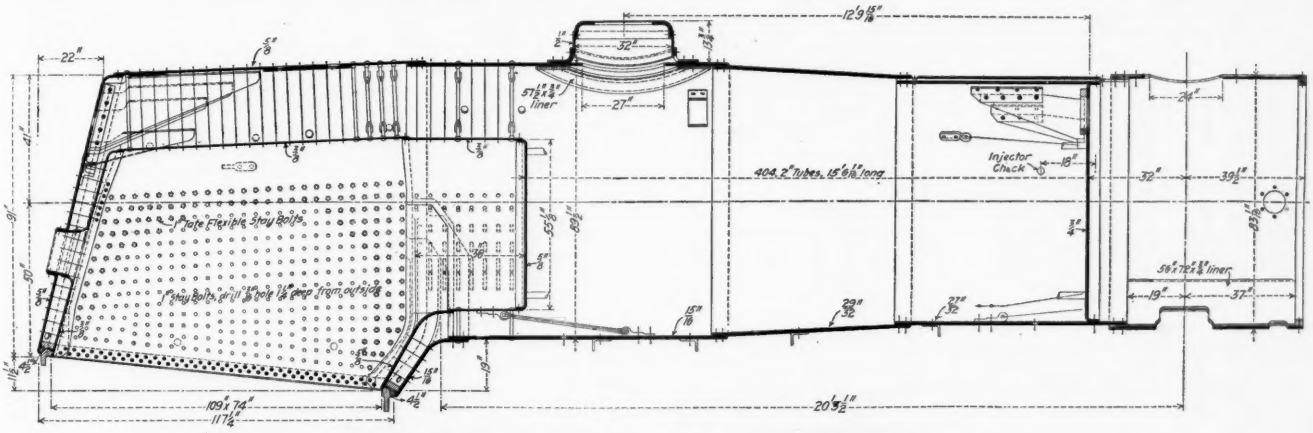
At the time the Northern Pacific engines were built some considered it doubtful practice to make such a reduction in tube heating surface, but the results seem to have justified it, for the work on the Northern Pacific has been quite satisfactory. The adoption of the combustion chamber on these B., R. & P. decapod engines was also warranted by an experience of 15 years on the part of Mr. Wilson, Superintendent of Motive Power of the Buffalo, Rochester & Pittsburg, with anthracite and bituminous coal burning engines, both with and without combustion chambers, which had taught him that the combustion chamber was no experiment. The well-known advantages claimed are that the tubes are removed from the hottest part of the fire, thereby decreasing flue leakage and giving an increased firebox volume which greatly assists combustion. At the same time the loss of heating surface due to the shorter tubes is met by an increase in the firebox heating surface.

In these engines the combustion chamber is 3 ft. long, and is stayed to the shell by radial and sling stays in the upper section and by radial stays on the sides and bottom. Braces are also attached to the bottom and these extend forward to the waist to add stiffness. There is 10½ in. clearance between the bottom of the combustion chamber and the shell to insure a free circulation, and this is tapered down to 4½ in. at the foundation ring, which is only 19 in. below the shell. At the back, the top of the foundation ring is but 3½ in. below the same point, so that the supply of water coming back into the water legs to take the place of that evaporated has very little drop in order to reach the lowest point.



Decapod Locomotive; Buffalo, Rochester & Pittsburg.

The boiler is of the wagon-top type 80 in. in diameter, and contains 3,535.5 sq. ft. of heating surface, with 404 tubes 15 ft. 6 1/16 in. long. The introduction of the combustion chamber, of course, reduces the amount of tube heating surface, but experience on the Northern Pacific has proven that the increase of firebox heating surface more than offsets this loss, and that engines with a combustion chamber and less actual or even equated heating surface, steam fully as well as those without the combustion chamber and more heating surface. Assuming the Vaughan formula to be correct, the larger firebox, by causing a better rate of combustion, delivers more heat to the tubes proportionately than the ordinary firebox can do, and so raises their efficiency per foot of length.



Boiler of Decapod Locomotive; Buffalo, Rochester & Pittsburg.

The back head has a slope of 22 in. and the fire door is formed by the outward flanging of the two sheets and the use of a welded plate ring to connect them. The large diameter of the shell and the high steam pressure (210 lbs.) require the use of very heavy sheets, which are 15/16 in., 29/32 in. and 27/32 in. thick. In the staying of the firebox the distribution of the flexible stays is somewhat different from that used in other engines recently illustrated in the *Railroad Gazette*. The usual arrangement is a single row of flexible stays up the front and back of the side sheets, with another across the top and clusters in the upper corners. In this case, with a firebox of nearly the same dimensions, there are three rows at

the front, and two at the back and top, with a clustering in the corners. This difference may be due to a variety of causes, but it serves to show that there is, as yet, no standard of practice in this detail.

The cylinders are 24 in. in diameter, with a piston stroke of 28 in. The slide valves are outside admission, operated by the Walschaert gear. The link is supported by a casting of special shape secured to the back of the guide yoke and the reverse shaft is carried in bearings bolted to the top of a cast steel cross-tie located between the second and third pair of driving wheels by which a direct connection of the reverse shaft arm with the radius bar is made possible. This arrangement of the Walschaert gear emphasizes again the facility which it affords for the cross bracing of the frames. In this case there are five points between the cylinders and the firebox where braces are put in.

The equalization is in two groups; the front group includes the truck and the first two pairs of drivers, and the rear group includes the three last pairs. It is arranged with flat yokes over the driving boxes and semi-elliptic springs under the upper rail of the frame taking the place of equalizing levers.

Another interesting feature of these engines is the unusually large capacity of the tender. The tank is of the water bottom type and has a capacity of 9,000 gallons, which is probably the largest water capacity ever provided in a locomotive tender.

In comparing the dimensions and ratios of these engines that follow, with those of other or similar types, it must be borne in mind that the introduction of the combustion chamber introduces a wide variation in all those ratios where either tube, firebox or total heating surface is considered, as compared with engines having no combustion chamber. In order to make such comparisons, the equated heating surfaces should be used.

The principal dimensions and ratios of these engines are:

Cylinder diameter	24 in.
Piston stroke	28 "
Wheel base, driving	19 ft. 0 "
" " total engine	28 " 4 "
" " total engine and tender	65 " 3¼ "
Weight on drivers	243,000 lbs.
" total engine in working order	268,000 "
" total engine and tender	432,000 "
Heating surface, tube	3,280.0 sq. ft.
" " firebox	255.5 "
" " total	3,535.5 "
Grate area	55.5 "
Journals, main driving	10½ in. x 13 in.
" trailing driving	10 " x 13 "
" track	6½ " x 12 "
" tender	5½ " x 10 "
Boiler, diameter, first ring	80 "
Firebox, length	108 "
" width	73¼ "
" thickness, crown, side and back sheets	⅜ in.
" thickness tube sheet	⅝ in.
" water space	4½ in.
Steam pressure	210 lbs.
Tubes, number	404
" diameter	2 in.
" gage	No. 11
" length	15 ft. 6 1/16 in
Tank capacity, water	9,000 gals.
Tank capacity, fuel	14 tons
Valves, travel	6¼ in.
" lap	1 "
" lead	3/16 in.
Wheels, diameter, driving	52 in.
" " truck	30 "
" " tender	33 "
Tractive power	55,350 lbs.

$$\frac{\text{Weight on drivers}}{\text{Total weight}} = 0.90$$

$$\frac{\text{Weight on drivers}}{\text{Tractive power}} = 4.5$$

$$\frac{\text{Total weight}}{\text{Tractive power}} = 4.84$$

$$\frac{\text{Tractive power x diameter drivers}}{\text{Heating surface}} = 815.0$$

$$\frac{\text{Heating surface}}{\text{Grate area}} = 63.6$$

$$\frac{\text{Firebox heating surface}}{\text{Total heating surface}} = 7.79 \text{ per ct.}$$

$$\frac{\text{Weight on drivers}}{\text{Total heating surface}} = 70.3$$

$$\frac{\text{Total weight}}{\text{Total heating surface}} = 81.7$$

Volume of 2 cylinders = 14.62 cu. ft.

$$\frac{\text{Total heating surface}}{\text{Volume of 2 cylinders}} = 241.5$$

$$\frac{\text{Grate area}}{\text{Volume of 2 cylinders}} = 3.8$$

Tube heating surface, equated to firebox heating surface (Vaughan's formula)	= 830.5 sq. ft.
Total equated firebox heating surface	= 1,086.0 "
Ratio of equated firebox to total actual heating surface	1 :3.02

New Feed-Water Heater for Locomotives.

F. H. Trevethick, General Manager of the Egyptian State Railroads, has adopted a new method of heating the feed-water for locomotives working between Cairo and Alexandria, which is described in a recent issue of the *Revue Industrielle*. The water is heated by the exhaust steam in combination with the waste heat of the smokebox gases.

The feed water is forced into the boiler by a horizontal motor pump placed on the left-hand side of the firebox, and using steam at full boiler pressure. The water passes from the pump through the first heater which is formed of a cylinder set vertically between the frames below the feed pump. It is 36 in. high and contains 90 steel tubes 7/16 in. in diameter, about which the exhaust steam is made to circulate. The steam condensed by the cold feed water is collected in the bottom of the cylinder and is removed by a pipe and cock. The feed water is taken from this first heater and sent on through a pipe 2½ in. in diameter to second and third heaters which are set horizontally outside the cylinders in such a way as to receive a part of the exhaust steam on its way to the stack. The condensing surface, which is the same in the three, is formed of 42 tubes 7/16 in. in diameter and 5 ft. 6 in. long, set in a cylindrical box. The second heater, which is on the right-hand side, is divided by a partition in such a way that the water traverses it twice in going through; in the third heater there is no such partition. The water passes from the third heater into a fourth heater, formed of an annular chamber placed in the smokebox and containing 265 water tubes of 1 in. inside diameter and 18 in. long, arranged in three concentric rings, which finally deliver to the boiler on its center line directly back of the smokebox.

The successive temperatures attained by the water in the course of its circulation through the four heaters are as follows:

Initial temperature on leaving tender	68 deg. F.
Temperature on leaving first heater	82 "
" " " second heater	171 "
" " " third heater	203 "
" " " fourth heater	280 "

The estimated saving of fuel, under ordinary working conditions, is about 16 per cent.; but compared with the ordinary methods of operation, using injectors, the saving is more than 17 per cent. The averages of the results obtained in eight runs with heaters and eight without the heaters are given in the following table:

Heaters.	No. of trips.	Coal.	Weight of train (net).	Speed per hour.	Temperature of feedwater.	Point of cut-off
Used	8	2,887.5 lbs.	251.08 tons	48.11 miles	252 deg. F.	23.6 per ct.
Not used	8	3,722.4 "	254.10 "	46.62 "	...	25.1 "

The distance from Cairo to Alexandria is about 129 miles, and is covered by express trains making four stops in 3 hrs. 5 min.; the longest run without a stop being 74.4 miles. The coal consumption on the run from Cairo to Alexandria is about 12 per cent. more than in the opposite direction, during the summer months, because of the continual northwest winds that prevail and to which the line is especially exposed. This increase is quite marked in the detailed record of coal consumption for the several trips of the test and obtains both with and without the use of the heaters.

The consumption of coal per net ton of weight hauled was 10.45 lbs. when the heaters were used and 13.30 lbs. when they were cut out, showing that the heaters effected a saving of 21.4 per cent., or that it was necessary to burn 27.3 per cent. more coal when they were not in use. The price of coal in Alexandria is about $5 per net ton, and the cost of installing the heaters was about $1,250 per engine, representing an annual charge of about $187.50 for interest and depreciation, while the annual saving effected in 720 trips would be about 300 tons, or a net gain of about $1,300, which would be more than sufficient to pay for the equipment in a year. In an engine of this character exhibited at Milan especial provision was made in the arrangement of the smokebox heater, so that it could be used as a superheater for the steam, in case it should be desired either to cut out the heaters or use an injector instead of the pump.

Manganese Bronze Staybolts.*

The *Revue Générale* published in March, 1901, a note regarding an attempt being made by the Northern Railway of France to do away with the grave troubles due to the breakage of copper staybolts in high-pressure locomotive boilers.

Since this time the experiments have been continued, and although they have not been extended to any large number of boilers they have sufficed to justify the step, taken in May, 1904, of using manganese bronze staybolts for all locomotive boilers with a pressure of more than 185 lbs. per sq. in. One of the tests was carried out with a series of 15 locomotives, of the compound 10-wheeled type (4-6-0) designed under the direction of Mr. du Bousquet, and built in the shops of the Northern Railway for the Ceinture Railway of Paris. Mr. Koechlin, who carried out the designs of these

*Translated from a paper by M. Rodrigue, Chief Engineer of Central Service, Northern Ry. of France; printed in the *Revue Generale des Chemins de Fer*, July, 1907.

engines, described them in the *Revue Générale* of May, 1904. We will only recall at present that the boiler pressure was 227 lbs. per sq. in.

As soon as these engines went into service there were a large number of failures of the copper staybolts, and it was decided to keep a special record of this trouble. As built, the boilers were equipped with manganese bronze staybolts in the three upper rows and in the corners of the fireboxes, and on account of the large number of failures of the copper stays when the engines first went into service, Mr. du Bousquet decided to equip two of the locomotives with manganese bronze staybolts throughout.

The 15 engines were delivered during the latter half of 1902 and a careful record kept of all staybolt failures. The results are given in the accompanying table, which has been drawn up to show for each engine and for the whole series the number of staybolts replaced during each half yearly period after going into service.

It will be seen from this table that on engines 60 and 65 which were equipped throughout with manganese bronze staybolts, not a single staybolt was replaced during three years service, and that at the end of 4½ years there had been replaced only 58 staybolts of which the heads had worn down. On the other 13 engines during the same period of 4½ years the number of broken staybolts replaced was 3,978 of copper and three of manganese bronze, while 376 bronze staybolts were replaced on account of worn heads. That is to say, it was necessary to replace nearly 10 times as many copper as bronze staybolts.

This is extremely interesting from the point of view of the cost, and of the inconveniences of all sorts which attend the replacing of staybolts, but it is still more striking if one considers the breakage of the staybolts which is the most important consideration from the point of view of safety. During the period of 4½ years only three bronze staybolts broke as against 3,978 of copper.

This result would have been even more strikingly in favor of the bronze bolts if the broken copper staybolts had not been replaced by bronze. It will be seen that the number of breakages of the copper bolts, which was 983 in the first six months, fell off rapidly. If the same rate of breakage had been maintained it would have been necessary in the 4½ years to replace practically all of the copper staybolts in the 13 engines.

These figures show clearly that manganeze bronze is superior to copper for staybolts for locomotive boilers with high pressure. If the initial cost is higher it is largely offset by the savings effected during the first few months in service.

TABLE SHOWING THE NUMBER OF FIREBOX STAYS REPLACED IN HALF-YEARLY PERIODS ON EACH OF 15 LOCOMOTIVES, FROM JUNE, 1902, TO DEC. 31, 1906.

No. half-yearly period	1.		2.		3.		4.		5.		6.		7.		8.		9.		Total No. of staybolts replaced on each engine.	
Age loco. at end each period	6 mos.		12 mos.		18 mos.		2 years		2½ yrs		3 yrs		3½ yrs		4 yrs.		4½ yrs			
Stays replaced	C.	B.	C.	B.	C.	B.	C.	B.	C.	B.	C.	B.	C.	B.	C.	B.	C.	B.	C.	B.
Engine No. 51.....	138	...	54	...	70	...	49	...	19	...	13	...	21	...	78	...	18	34	460	34
" " 52.....	160	...	76	...	68	...	41	...	27	...	24	...	3	...	43	...	15	9	457	9
" " 53.....	175	...	94	...	62	...	30	...	19	...	16	...	7	...	15	27	7	11	425	38
" " 54.....	87	...	58	...	29	...	45	...	28	...	37	...	7	...	28	25	19	1[1]	338	26
" " 55.....	14	...	20	...	16	...	5	...	11	...	21	...	15	...	49	2	23	1[2]	171	3
" " 56.....	18	...	17	...	31	...	23	...	13	...	14	...	103	...	15	...	28	27	262	27
" " 57.....	59	...	26	...	28	...	26	...	22	...	2	...	24	...	8	19	7	...	202	19
" " 58.....	41	...	21	...	13	...	15	...	15	...	11	...	38	...	3	...	..	...	157	..
" " 59.....	26	...	38	...	29	...	23	...	13	...	31	...	61	20	8	...	..	...	229	20
" " 60.....	..	...	..	...	..	...	..	...	..	...	..	...	..	...	..	28	..	...	...	28
" " 61.....	164	...	121	...	44	...	58	...	18	...	4	...	31	...	21	...	3	40[3]	464	40
" " 62.....	14	...	53	...	51	...	46	...	25	...	17	...	2	...	44	...	102	82	354	82
" " 63.....	35	...	18	...	21	...	16	...	7	...	10	...	8	...	49	8	17	...	182	8
" " 64.....	51	...	33	...	57	...	9	...	10	...	40	...	39	...	35	15	..	...	274	15
" " 65.....	..	...	..	...	..	...	..	...	..	...	..	...	..	...	..	30	..	...	...	30
Totals	983	...	629	...	519	...	386	...	227	...	240	...	359	20	396	154	239	205	3,978[4]	379[5]

Each firebox had originally 708 (C.) copper, 176 (B.) manganese bronze, a total of 884 stays, except on Engines 60 and 65, where all the firebox stays were of manganese bronze.

[1] Manganese bronze staybolt applied Jan. 17, 1903, and broken in September, 1906.
[2] Manganese bronze staybolt applied May 3, 1903, and broken in October, 1906.
[3] Of these, one manganese bronze staybolt was applied Nov. 14, 1902, and broken in September, 1906.
[4] These 3,978 copper staybolts were replaced because of breakage.
[5] Of these, 376 were replaced because the heads were worn, and 3 because of breakage. The 376 of which the heads were worn were all in the zone below the firebrick arch.

Standard Oil Company Fined $29,240,000.

In the United States District Court in Chicago, August 3, Judge K. M. Landis imposed on the Standard Oil Company of Indiana, as the penalty for accepting unpublished rates on 1,462 shipments of oil from Whiting, Ind., to East St. Louis, fines aggregating $29,240,000, or a $20,000 fine for each offense. The Judge at the same time recommended that a special grand jury be convened to consider the question of the guilt of the Chicago & Alton Railroad, which was the other party to these offenses, and this is being done.

The trial of these cases was begun in Chicago, March 4, and was finished April 13. Arguments for a new trial were heard but were denied, and Judge Landis then called John D. Rockefeller and other officials to testify as to the relations of the Standard Oil Company of Indiana to the Standard Oil Company of New Jersey. It was found that the Indiana corporation was owned by the other. It appears that the total of the assets of the Indiana company is far less than the amount of the fines.

The offense in this case was that of accepting from the Chicago & Alton a rate of 6 cents per 100 lbs. on oil in carload lots from Whiting, Ind., to East St. Louis, Ill., when the published tariff rate was 18 cents per 100 lbs. The oil company claimed that the railroad had misled it into the belief that 6 cents was the legal rate, and that tariffs showing it had been filed with the Interstate Commerce Commission, but the court held that, as the law required freight tariffs to be posted in the freight offices for public inspection, it was the oil company's duty to know whether or not the rate given to it was lawful.

The President of the Standard Oil Company of Indiana, in a statement given to the newspapers, says that the 18-cent rate was a class and not a commodity rate, and that the chairman of the Chicago and St. Louis Traffic Association, the association issuing the 18-cent class rate, under oath testified that it was never applied and was never intended to apply to oil. Continuing, he says: "Thousands of tons of freight have been shipped from these points during the past 15 years under the same circumstances as the Standard shipments, and if the Standard is guilty in this case, so is practically every other shipper in this great manufacturing territory.

"The Standard Oil Company shipped about one-third of all the oil that went from Whiting to East St. Louis over the Eastern Illinois, the other two-thirds going over the Alton and the Burlington. On the trial of the case the defendant offered to show by witnesses who were on the stand that not only during the period of time covered by the indictment, but continuously from 1895, the Eastern Illinois had a lawful published and filed rate between Whiting and East St. Louis on oil of 6 cents per 100 lbs., and that the Standard Oil Company shipped at such rate over the Eastern Illinois more than 2,000 cars of oil each year during said period. To this offer the Government through its attorneys strenuously objected, and the court sustained such objection. The defendant contended, and still does contend, that this proof would have conclusively shown that the Standard Oil Company had no possible motive in shipping over the Alton, and thereby violating the law, when it might just as readily and conveniently have shipped all of its oil over the Eastern Illinois, and not have violated any law.

"Under such circumstances, and in view of the fact that petroleum had been openly carried over the three roads from Whiting to East St. Louis for from 10 to 14 years for 6 cents, it is a severe draft on human credulity for the prosecution to assert that 18 cents was the only possible lawful rate. The uncontradicted evidence also showed the Standard Oil Company was advised by the rate clerk of the Chicago & Alton that this 6-cent rate was filed with the Interstate Commerce Commission.

"The court, however, instructed the jury that the shipper must know not only what the rate was, but also that such rate was actually filed with the Interstate Commerce Commission. That is to say, the view of the court was that a shipper must know absolutely what was the legal rate, at the risk of suffering enormous penalties, in the event either that he was misinformed by the railroad company, or in the event that he did not exercise as much diligence as, in the judgment of the court, he should have exercised in ascertaining what the rate really was.

"Knowing that the rate on the Eastern Illinois was but 6 cents, having no reason for shipping over the Alton in preference to the Eastern Illinois, and able to ship all of its oil over the latter road, we insist that the facts, many of which the court did not permit us to show, not alone demonstrate innocence, but inherently forbid the idea of guilt."

The Railroads of Mexico.*

BY ERDIS G. ROBINSON, C.E.
Formerly of the Engineering Department of the Mexican Central.

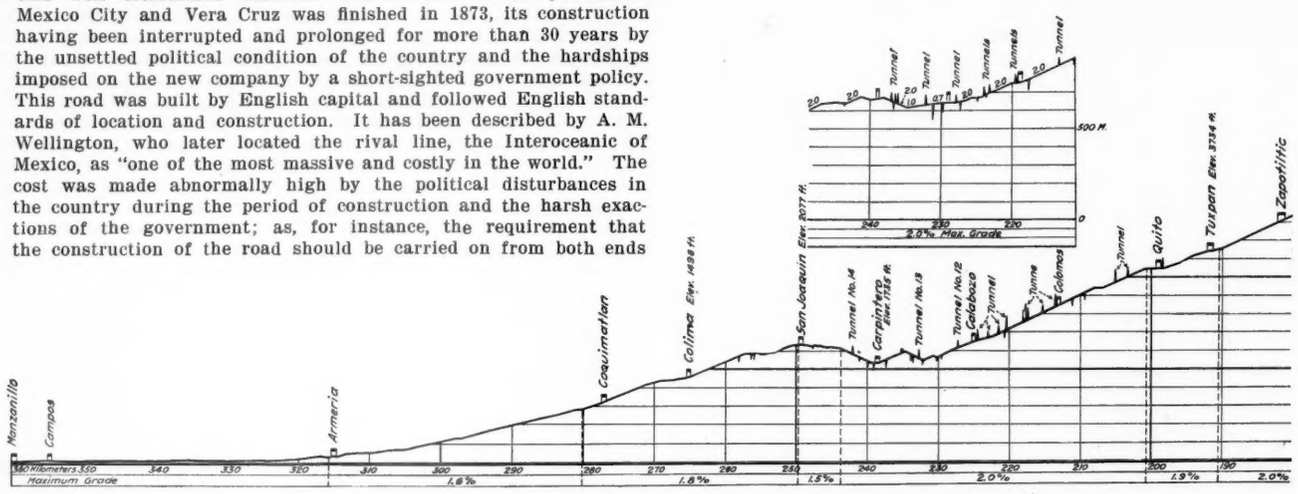
II.

THE PRINCIPAL RAILROADS.

Vera Cruz had early become the main Atlantic seaport of Mexico; even before the advent of the railroad a considerable business was handled at that port. The town was connected with the City of Mexico by an excellent road which became established as a regular traffic route. Therefore it was to be expected that the first line of railroad to be built in the country should be one to handle this well established business. The Mexican Railway between Mexico City and Vera Cruz was finished in 1873, its construction having been interrupted and prolonged for more than 30 years by the unsettled political condition of the country and the hardships imposed on the new company by a short-sighted government policy. This road was built by English capital and followed English standards of location and construction. It has been described by A. M. Wellington, who later located the rival line, the Interoceanic of Mexico, as "one of the most massive and costly in the world." The cost was made abnormally high by the political disturbances in the country during the period of construction and the harsh exactions of the government; as, for instance, the requirement that the construction of the road should be carried on from both ends simultaneously, which entailed extremely heavy transportation expenses on construction materials. Mr. Wellington has estimated that the cost of construction was doubled by such hindrances. Therefore, dividing the actual cost by two, he estimated that the 223 miles of comparatively light work cost about $40,000 a mile, while the 60 miles of heavy work cost about $185,000 a mile, thus making an average for the whole road of $70,670 a mile. Notwithstanding this heavy cost of construction, the grades and curves are more severe than those of any other line in Mexico. On the mountain section there are uncompensated grades of 4 per cent., with curves of 325 ft. radius (about 18 deg.), often with no tangent between reverse curves. Although the volume of business is large, operating expenses are high. The high cost of construction also makes interest charges large.

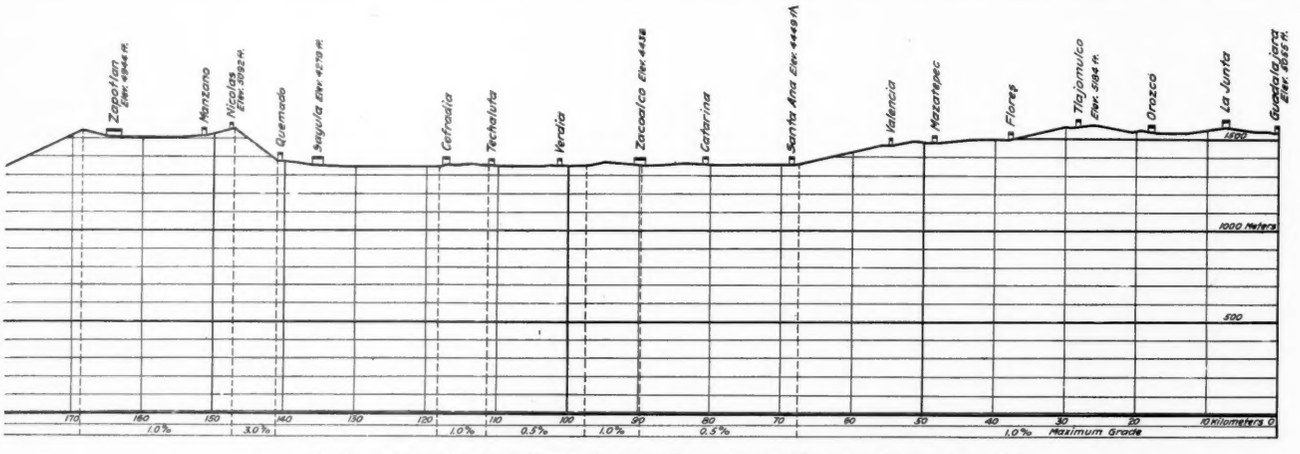
The volume of business at Vera Cruz later tempted other English capitalists to undertake construction of a second line from that port to Mexico City. The preliminary survey of this line was in charge of Mr. Wellington. His description of the work in a paper presented to the American Society of Civil Engineers is of unusual interest. The new line, the Interoceanic, parallels the older road in that it connects the same terminal cities, but otherwise departs widely from it. Although built to handle the business between Vera Cruz and Mexico City, its length was materially increased in order to reach two important cities, Jalapa and Puebla, which were not on the line of the Mexican Railway, this location being entirely consistent with the principles so ably advocated by Mr. Wellington in his "Economic Theory of Railroad Location." The Mexican Railway was projected to handle the through business and neglected local possibilities; the other road was lengthened so as to include certain intermediate cities at the cost of longer haul on its through traffic. It is interesting to note that it has been found advisable to alter both locations. The Mexican Railway has built a branch line to reach the city of Puebla, while the Interoceanic has built a cut-off which reduces the length of through haul by which that same city is left at one side.

The Interoceanic Railway was built with narrow gage, the grade kept down to 2 per cent. (uncompensated) and curvature to 289 ft. radius (20 deg.). The 2 per cent. grade extends unbroken for nearly 75 miles. The estimated cost of this road was $40,000 a mile, about one-half of that of the earlier road. The gross earnings are about the same for both roads, not far from $3,000,000 a year.



Profile of the Mexican Central's Line from Guadalajara to Manzanillo (1).

Extending to the south from Vera Cruz is one of the newer roads, the Vera Cruz & Pacific, built to exploit the rich tropical lands and to connect with the Tehuantepec National Railway, which crosses the isthmus of that name. The Tehuantepec road is interesting in that its construction was undertaken directly by the Mexican Government and marked the entrance of the government into the railroad field. The road follows the route of the line proposed by Captain Eads for a ship railroad and crosses a summit of only 850 ft. elevation.



Profile of the Mexican Central's Line from Guadalajara to Manzanillo (2).

The second company to enter Mexico was the Mexican Central. The organization of this road in 1880 was followed vigorously by surveys and construction, and in 1884 the line was completed from El Paso to the City of Mexico, 1,225 miles. This was the first road to be built under a law passed in 1880 to encourage railroad building. It received a government subsidy of $15,000 a mile, free importation of construction material and exemption from all taxation for 50 years.

The general location of this road has met with considerable

*The first article was published in the *Railroad Gazette* of July 12, 1907.

criticism. The line follows the entire length of the high plateau in the western part of Mexico, and therefore its through route for international business is unnecessarily long. It was projected by men who had been building in the western part of the United States roads like the Atchison, Topeka & Santa Fe whose prosperity was dependent on the future development of the tributary country. The Mexican Central was located on the same theory. That to depend largely on local business was the correct view is indicated by the fact that the international freight and passenger business of the road is only 30 per cent. of its total traffic, and that much of the local traffic comes from the northern part of the road. The growth of this company has been constant. The branch to Tampico, the second most important port in Mexico, was finished in 1890. During 1908 a line to the Pacific coast at Manzanillo will be put in operation. The Tampico branch makes the sharp descent from the plateau over a country similar to that crossed by the Mexico City-Vera Cruz lines; while the Pacific extension crosses the great Sierra Madre range. Though penetrating a more difficult country than is encountered by any other Mexican road, this extension is to have the easiest grades and lightest curvature of any line to either coast, a result which will be obtained only after most careful location and costly work. A Fellow of the Royal Geographical Society has said in regard to this extension:

"I have seen some of the most apparently hopeless problems of circumvention overcome, such as the magnificent bit of line from Wellington in Cape Colony; the 5,000-ft. climb of the La Guira & Caracas Ry. in Venezuela; the stupendous passage over the Sierras of the Sao Paulo Ry. in Brazil, and the clever piece of construction work on the Mexican Railway. In my opinion the new line from Tuxpan to Colima [the Mexican Central's Pacific extension] is incomparably more imposing than any of these and infinitely more difficult."

A topographic map and profile of this new extension are shown. The following table shows the rates of grade and costs of construction of certain mountain divisions of various Mexican railroads.

TABLE I.—*Rates of Grade and Cost of Construction on Mountain Divisions of Mexican Railroads.*

Name of railroad.	Location of grade.	Length of grade, miles.	Average cost per mile (U. S. currency).	Rate, grade, per cent.	Radius of curvature (ft.).	Deg. curve (100 ft. chord).	Gage.
Mexican Central.	Tampico division	27	.....	3	262	22	S.
" "	Cuernevaca division..	25	.....	3½	...	..	S.
" "	Colima extension....	100	$50,000	2	627	9	S.
" "	Tuxpan-Colima	40	57,000	2	627	9	S.
" "	Colima-Manzanillo ..	60	335,500	2	627	9	S.
" "	Tuxpan-Colima	1	200,000	2	627	9	S.
Mexican Railway.	Vera Cruz, main line.	60	185,000	5	320	18	S.
" "	Vera Cruz, main line.	283	70,670	5	320	18	S.
Interoceanic.....	Vera Cruz, main line.	73	40,000	3	262	22	N.

S = Standard gage.; N = Narrow gage.

The Mexican National Railway, now the National Railway of Mexico, was projected to form a short line from Mexico City. It was promoted by men interested in the Denver & Rio Grande and other narrow gage roads in this country, and was intended to form part of a large system of affiliated narrow gage lines. The Mexican National operated for many years at a great disadvantage in handling its through business. A few years ago it was changed to standard gage. This change made, the fact that it is much shorter than any other line to the eastern part of the United States gives it an advantage over its competitors.

The Mexican International Railway, built by the Huntington interests, crosses the plateau from the international boundary at Eagle Pass, the rich mining city of Durango. This was built standard gage and crosses a country which required only light grades. It crosses the Mexican Central at Torreon. For many years it was virtually a feeder of that system and by means of a traffic agreement served as a short outlet for the through business of that road. Mineral products form a larger percentage of this company's traffic than of any other of the larger roads of Mexico, being something like 75 per cent.

Is it not possible that the promoters of these roads have builded better than they knew, in view of recent developments in the railroad situation in Mexico? The proposed absorption of all these railroads except the Mexican Railway in the government merger by which competition will be done away with, makes it appear fortunate that the different lines were laid out on different principles—some to promote local business, some to handle through traffic, and some to care largely for mineral traffic. The business coming to the railroads in Mexico has not generally been of sufficient magnitude to encourage the construction of many competing parallel lines so that the way was made easy for the formation of government's merger.

(To be continued.)

Topography of the Mexican Central's Pacific Coast Extension.

Standard Specifications for Structural Timber.

Committee Q of the American Society for Testing Materials at the annual meeting of the society last month presented the following proposed specifications for grading structural timber:

STANDARD DEFECTS.

The definitions of standard defects are as follows:

Measurements which refer to the diameter of knots or holes should be considered as referring to the mean or average diameter.

1. *Sound Knot.*—A sound knot is one which is solid across its face and which is as hard as the wood surrounding it; it may be either red or black, and is so fixed by growth or position that it will retain its place in the piece.

2. *Loose Knot.*—A loose knot is one not firmly held in place by growth or position.

3. *Pith Knot.*—A pith knot is a sound knot with a pith hole not more than ¼ in. in diameter in the center.

4. *Encased Knot.*—An encased knot is one which is surrounded wholly or in part by bark or pitch. Where the encasement is less than ⅛ in. in width on both sides, not exceeding one-half the circumference of the knot, it shall be considered a sound knot.

5. *Rotten Knot.*—A rotten knot is one not as hard as the wood it is in.

6. *Pin Knot.*—A pin knot is a sound knot not over ½ in. in diameter.

7. *Standard Knot.*—A standard knot is a sound knot not over 1½ in. in diameter.

8. *Large Knot.*—A large knot is a sound knot, more than 1½ in. in diameter.

9. *Round Knot.*—A round knot is one which is oval or circular in form.

10. *Spike Knot.*—A spike knot is one sawn in a lengthwise direction; the mean or average width shall be considered in measuring these knots.

11. *Pitch Pockets.*—Pitch pockets are openings between the grain of the wood containing more or less pitch or bark. These shall be classified as *small, standard* and *large* pitch pockets.

(*a*) *Small Pitch Pocket.*—A small pitch pocket is one not over ⅛ in. wide.

(*b*) *Standard Pitch Pocket.*—A standard pitch pocket is one not over ⅜ in. wide, or 3 in. in length.

(*c*) *Large Pitch Pocket.*—A large pitch pocket is one over ⅜ in. wide, or over 3 in. in length.

12. *Pitch Streak.*—A pitch streak is a well-defined accumulation of pitch at one point in the piece. When not sufficient to develop a well-defined streak, or where the fiber between grains, that is, the coarse-grained fiber, usually termed "Spring wood," is not saturated with pitch, it shall not be considered a defect.

13. *Wane.*—Wane is bark, or the lack of wood from any cause, on edges of timbers.

14. *Shakes.*—Shakes are splits or checks in timbers which usually cause a separation of the wood between annual rings.

15. *Rot, Dote and Red Heart.*—Any form of decay which may be evident either as a dark red discoloration not found in the sound wood, or the presence of white or red rotten spots, shall be considered as a defect.

16. *Ring Shake.*—An opening between the annual rings.

17. *Through Shake.*—A shake which extends between two faces of a timber.

STANDARD NAMES FOR STRUCTURAL TIMBERS.

The following trade names are recommended:

1. *Southern Yellow Pine.*—Under this heading two classes of timber are used, (*a*) longleaf pine, (*b*) shortleaf pine.

It is understood that these two terms are descriptive of quality, rather than of botanical species. Thus, shortleaf pine would cover such species as are now known as North Carolina pine, loblolly pine and shortleaf pine. "Longleaf pine" is descriptive of quality, and if Cuban, shortleaf or loblolly pine is grown under such conditions that it produces a large percentage of hard summer wood, so as to be equivalent to the wood produced by the true longleaf, it would be covered by the term "longleaf pine."

2. *Douglas Fir.*—The term "Douglas fir" to cover the timber known likewise as yellow fir, red fir, western fir, Washington fir, Oregon or Puget Sound fir or pine, norwest and west coast fir.

3. *Norway Pine,* to cover what is known also as "red pine."

4. *Hemlock,* to cover southern or eastern hemlock; that is, hemlock from all states east of and including Minnesota.

5. *Western Hemlock,* to cover hemlock from the Pacific coast.

6. *Spruce,* to cover eastern spruce; that is, the spruce timber coming from points east of Minnesota.

7. *Western Spruce,* to cover the spruce timber from the Pacific coast.

8. *White Pine,* to cover the timber which has hitherto been known as white pine, from Maine, Michigan, Wisconsin and Minnesota.

9. *Idaho White Pine,* the variety of white pine from western Montana, northern Idaho and eastern Washington.

10. *Western Pine,* to cover the timber sold as white pine coming from Arizona, California, New Mexico, Colorado, Oregon and Washington. This is the timber sometimes known as "Western yellow pine," or "Ponderosa pine," or "California white pine," or "Western white pine."

11. *Western Larch,* to cover the species of larch or tamarack from the Rocky Mountain and Pacific coast regions.

12. *Tamarack,* to cover the timber known as "Tamarack," or "Eastern Tamarack," from states east of and including Minnesota.

13. *Redwood,* to include the California wood usually known by that name.

STANDARD SPECIFICATIONS FOR BRIDGE AND TRESTLE TIMBERS.

(To be applied to solid members and not to composite members.)

General Requirements.

Except as noted all timber shall be cut from sound trees and sawed standard size; close grained and solid; free from defects such as injurious ring shakes and crooked grain; unsound knots; knots in groups; decay; large pitch pockets, or other defects that will materially impair its strength.

Standard Size of Sawed Timber.—Rough timbers when sawed to standard size, shall mean that they shall not be over ¼ in. scant from actual size specified. For instance, a 12-in. x 12-in. shall measure not less than 11¾ in. x 11¾ in.

Standard Dressing of Sawed Timbers.—Standard dressing means that not more than ¼ in. shall be allowed for dressing each surface. For instance, a 12-in. x 12-in. shall after dressing four sides, not measure less than 11½ in. x 11½ in.

Stringers.

1. *Longleaf Yellow Pine and Douglas Fir.*—Shall show not less than 80 per cent. of heart on each of the four sides, measured across the sides anywhere in the length of the piece; loose knots, or knots greater than 1½ in. in diameter, will not be permitted at points within 4 in. of the edges of the piece.

2. *Longleaf Yellow Pine, Shortleaf Pine, Douglas Fir and Western Hemlock.*—Shall be square edged, except it may have 1 in. wane on one corner. Knots must not exceed in their largest diameter one-quarter the width of the face of the stick in which they occur. Ring shakes extending not over one-eighth of the length of the piece are admissible.

Caps and Sills.

1. *Longleaf Yellow Pine and Douglas Fir.*—Shall show 85 per cent. heart on each of the four sides, measured across the sides anywhere in the length of the piece; to be free from knots over 2½ in. in diameter; knots must not be in groups.

2. *Longleaf and Shortleaf Yellow Pine, Douglas Fir and Western Hemlock.*—Shall be square edged, except it may have 1 in. wane on one corner, or ½ in. wane on two corners. Knots must not exceed in their largest diameter one-quarter the width of the face of the stick in which they occur. Ring shakes extending not over one-eighth the length of the piece are admissible.

Posts.

1. *Longleaf Yellow Pine and Douglas Fir.*—Shall show not less than 75 per cent. heart, measured across the face anywhere on the length of the piece; to be free from knots over 2½ in. in diameter, and must not be in groups.

2. *Longleaf and Shortleaf Yellow Pine, Douglas Fir and Western Hemlock.*—Shall be square edged, except it may have 1 in. wane on one corner, or ½ in. wane on two corners. Knots must not exceed, in their largest diameter, one-quarter the width of the face of the stick in which they occur. Ring shakes shall not extend over one-eighth of the length of the piece.

Longitudinal Struts or Girts.

1. *Longleaf Yellow Pine and Douglas Fir.*—Shall show one face all heart; the other face and two sides shall show not less than 85 per cent. heart, measured across the face or side anywhere in the piece; to be free from knots 1½ in. in diameter and over.

2. *Longleaf and Shortleaf Yellow Pine, Douglas Fir and Western Hemlock.*—Shall be square edged and sound; to be free from knots 1½ in. in diameter and over.

Longitudinal X-Braces, Sash Braces and Sway Braces.

1. *Longleaf Yellow Pine and Douglas Fir.*—Shall show not less than 80 per cent. heart on two faces and four square edges; to be free from knots over 1½ in. in diameter.

2. *Longleaf and Shortleaf Yellow Pine, Douglas Fir and Western Hemlock.*—Shall be square edged and sound; to be free from knots 2½ in. in diameter and over.

SPECIFICATIONS FOR CAR SILLS AND CAR FRAMING FOR FREIGHT CARS.

The following specifications are submitted as a preliminary report, it being the intention of the committee to give these further consideration during the coming year:

General Rules.

All timber shall be sound, sawed standard size, square edged, unless otherwise specified, free from unsound or loose knots, knot holes and ring shakes.

Standard Size of Sawed Timbers.—Rough timbers when sawed to standard size, shall mean that they shall not be over ¼ in. scant from actual size specified. For instance, a 12-in. x 12-in. shall measure not less than 11¾ in. x 11¾ in.

Standard Dressing of Sawed Timbers.—Standard dressing means that not more than ¼ in. shall be allowed for dressing each surface. For instance, a 12-in. x 12-in. shall after dressing four sides, not measure less than 11½ in. x 11½ in.

Sills.

1. *Longleaf Pine or Douglas Fir.*—Shall be square edged and show not less than 85 per cent. heart on wide faces, measured anywhere in the length of the piece; sound, tight knots less than 2 in. in diameter and standard pitch pockets permitted when not clustered; grain must be close and straight.

2. *Longleaf Pine, Shortleaf Pine, Norway Pine, Western Pine, Douglas Fir, Western Hemlock.*—Same specifications as for (1), except that sound, tight knots less than 2½ in. in diameter, if well scattered, will be permitted in longleaf pine and Douglas fir; wane not to exceed 10 per cent. of the width of adjacent faces will be permitted on opposite corners not to exceed one-half the length of the piece.

End Sills, End Plates, Posts, Braces and Carlines.

1. *White or Red Oaks.*—Shall show not less than 85 per cent. heart on each face, measured anywhere in the length of the piece; well-scattered, standard knots permitted.

2. *Longleaf Pine or Douglas Fir.*—Shall show not less than 85 per cent. heart on each face, measured anywhere in the length of the piece; must be close, straight-grained and free from all defects, except well-scattered, sound, tight knots, not over 1 in. in diameter.

Side Plates.

1. *Longleaf Pine, Douglas Fir.*—Shall show not less than 85

per cent. heart on wide faces, must be close, straight-grained; well-scattered, standard knots and standard pitch pockets permitted.

2. *Longleaf Pine, Douglas Fir, Western Pine, Western Hemlock, Shortleaf Pine.*—Same as for (1), except that a few well-scattered, large knots will be permitted in longleaf pine and Douglas fir.

FRAMING FOR BUILDINGS.

The following specifications for framing for buildings are submitted as a preliminary report, it being the intention of the committee to give further consideration to these during the coming year:

General Requirements.

All timber shall be cut from sound timber and sawed standard size, close grained, free from ring shakes, decay and unsound knots, or knots and other defects that will materially impair its strength and durability.

Standard Size of Sawed Timber.—Rough timbers when sawed to standard size, shall mean that they shall not be over ¼ in. scant from actual size specified. For instance, a 12-in. x 12-in. shall measure not less than 11¾ in. x 11¾ in.

Standard Dressing of Sawed Timbers.—Standard dressing means that not more than ¼ in. shall be allowed for dressing each surface. For instance, a 12-in. x 12-in. shall after dressing four sides, not measure less than 11½ in. x 11½ in.

Posts—Longleaf Yellow Pine.

Will admit 1 in. wane on corners as measured on faces of timber. Must be free from knots 3 in. in diameter or over, and knots must not be in groups.

Beams and Girders—Longleaf Yellow Pine.

Will admit 1 in. wane on one corner as measured on faces of timber. Sound knots less than 3 in. in diameter will be permitted on the vertical faces at points not less than one-quarter the depth from the edge of the piece; sound, tight knots not exceeding 1½ in. in diameter at other points, provided they are not in clusters.

Joists—Longleaf Yellow Pine, Shortleaf Yellow Pine.

All joists over 2 in. in thickness to comply with the requirements for beams and girders.

Joists 2 in. in thickness will admit sound knots, none of which in 2 x 4's should be larger than 2 in. in diameter on one or both sides of the piece, and on wider stock which do not occupy more than one-third of the cross-section at any point throughout its length if located at the edge of the piece; or more than one-half of the cross-section if located away from the edge; pith knots, or smaller or more defective knots which do not weaken the piece more than the knot aforesaid; will admit of seasoning checks, firm red heart, heart shakes that do not go through, wane three-quarters deep on edge, one-quarter the width and one-third the length of the piece, pitch, sap stains, pitch pockets, splits in ends not exceeding in length the width of the piece, a limited number of small worm holes well scattered, and such other defects as do not prevent its use as substantial structural material.

Railroad Legislation in Connecticut.

BY CLARENCE DEMING.

In a railroad sense the seven months' session of the Connecticut legislature just ended, the longest in the history of the state, has been, if not important, at least most incongruous and fantastic. The session opened last January under peculiar and exceptional conditions. The anti-corporation wave sweeping over the country had struck Connecticut also, though with one of its minor surges. There was sharp criticism of railroad influence over-exercised in the lobby, albeit it had been modified in the legislature of 1905 in which the persuasive tongue of President Mellen in his so-called "open air" lobby had been more effective than the usual agencies. Meanwhile the Mellen policy of absorbing street railway lines had practically combined interests formerly at war, which new condition the legislature now faced for the first time. But the climax of that policy in the state by which, under the lease of the Connecticut Railway & Lighting Company's property some $18,000,000 of watered stock had become a dividend paying security, had, just before the meeting of the legislature, been sharply assailed in the press and apparently provoked public resentment. It had been carried through under the lax legislation of former years and the added laxity of a flabby and "political" railroad commission; and on the face of the disclosures, it seemed pretty certain that the legislature would seek the back track and pass severe statutes to secure honest street railway capitalization.

This natural forecast fell far short of fulfillment and, indeed, was reversed. Unexpectedly at the opening of the legislature trolley schemes came in like a flood. The state is small, its populous centers laced with trolleys and practically all of its really profitable street railway territory long ago occupied; yet, if it had been virgin street railway soil, the onset of trolley enterprises could hardly have been greater. They were some 24 in number besides those of minor importance. Most of them were of the "cross country" type and not a few of them called for layout through regions well nigh barren of patronage. In the case of a considerable number the layouts were parallel to the steam lines. Others appeared to involve pocket charters pure and simple—charters held merely for an ultimate sale and with no intention to build. In one particular region there was also a suspicious grouping of layouts suggesting future consolidation and long distance parallels especially when conjoined with power companies seeking immense charter privileges. What had actually come to pass was that trolley promoters instead of being deterred by the public clamor against the Railway & Lighting "deal" had been stirred by its success to try to repeat it by securing charter rights, building the new trolleys on bonds placed—at a high broker's commission—with the investing public and bonusing the stock among the projectors.

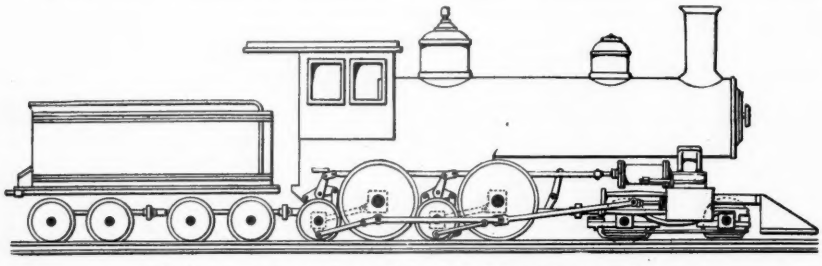
The promoters combined and went to work cleverly, drawing the "farm interest" into their net. In a Connecticut legislature this farm interest is very potential and, when united, dominant in the lower house, which at the last session contained 91 representatives who were farmers by vocation—in a house containing 255 members altogether—besides other members not farmers themselves but representing farm towns. This farm interest is to some extent consolidated in the granges of the state and much more effectively by the so-called "Farmers' Association" made up of members of the sitting legislature and holding a caucus at the opening of each legislative week to pass upon pending measures bearing on rural interests. Almost none of these farm members had seen previous legislative service and their ignorance of railroad and street railway questions was dense. On this soft timber, the more workable because green, the specious reasonings of the promoters were struck hard and cut deep. The benefits of the cities and larger towns from the trolleys as compared with the rural regions were contrasted. If the cities had parallel lines why couldn't the country have them too? The New Haven Railroad Company having now acquired the trolley roads, future extension must be left mainly to private enterprise; and such private enterprise would never try—in times like these with solid investments paying 5 per cent.—to link the farms with the cities unless "baited" by free gifts of street railway stocks as a bonus. These reasonings addressed to class selfishness prevailed in the lower house and, in most cases, in the Senate also. They were in brief: "Give us the trolleys and let the financing take care of itself." And the state of Connecticut, a *quasi* conservative and certainly a moneyed commonwealth, has been thus placed in the humiliating and discreditable position of approving dishonest street railway finance.

The trolley projects—except one or two which were a direct menace to the New Haven railroad—did not go through without stout resistance by Governor Woodruff who redeemed his pre-election pledge that his administration would be businesslike and not for party or persons. He sent in veto after veto of trolley charter bills, some 20 in number altogether. In almost all of these he urged in vain the undue opportunity for stock watering. But in all but two or three cases the bills were passed over his veto and so often that the certainty of an overruling vote became a theme of legislative laughter and jest. The temper of the Connecticut lawmakers was further indexed by the defeat of a bill for more careful and responsible engineering estimates of the value of new street railways as a basis for the amount of bonded debt. So far as it bears on street railways the substantial outcome of the session is the authorization of a new crop of watered trolley projects and pocket charters; and, in a larger civic sense, a most discouraging exhibit of blended ignorance, selfishness and fiscal laxity in the legislature of a New England state.

Steam railroad legislation of the session while not voluminous was stormy and the anti-corporation feeling much more in evidence than usual. The railroad interest secured control of the railroad and judiciary committees but in the latter case not without a contest which left behind bad blood, led to recrimination in the Senate and, incidentally, the passing of the lie between two Senators as to the nature and purpose of a joint interview with President Mellen. Sharp criticism of the New Haven company and personal attack upon its regular legislative counsel led to his withdrawal and the substitution of a new railroad attorney. Once again a bill was drawn modifying the four days car detention statute of the state; and, again, for the third successive legislative session it was withdrawn owing to resistance of the farm element and certainty of defeat in the lower house. Soon after the session opened the bill providing for issue of the New Haven company's convertible debentures was introduced with a pendant relating to mergers which, seemingly, added nothing to the corporation's existing charter powers. After a brief reverse in the lower house the measure went through and, in the sequel, it appeared that the annex cleared definitely the way, under Connecticut law, for the absorption of the Boston & Maine. Under new laws records of mergers by a railroad company must be filed with the Secretary of State; towns and cities can appeal for proper facilities in street railway service; hours of labor of railroad telegraphers and train despatchers are regulated and reduced; towns and cities can appeal to the railroad commission for orders to stop trains and street railway employees are

subjected to the same penalty as those of a railroad in case of injury to passengers. Except at minor points the appeal of the Governor for larger powers of the railroad commission was disregarded, the legislature possibly thinking that a body that has not exercised powers already possessed would not use larger ones if granted. Bitter criticism of the work of state commissioners and other state officers in the lobby led to the suppression during the session of their usual pernicious activity.

In the way of indirect legislation that may include railroads should be noted the outcome of an acute telephone contest which still leaves with the state courts the question of the public necessity and convenience in authorizing rival lines. The result hints somewhat strongly at the theory of "natural monopoly" in public utilities though it is doubtful whether many members of the legislature recognized the fact. Just at the close of the session the Governor's insistent demand for a temporary commission to investigate the subject of public utilities legislation came to a head forced by his threat to summon an extra session if the legislature failed to act. A brief and loose law, naming the commissioners and thus taking their appointment out of the Governor's hands, was passed—in the lower house by a party vote. The commission of five is a weak one, deeply infused with politics, four of the five state officers present or past and, presumptively, representing corporation interests by which they were named. It is a body whose opportunity is likely to be larger than its courage or its works.



Bothwell Principle Applied to 8-Wheel Locomotive.

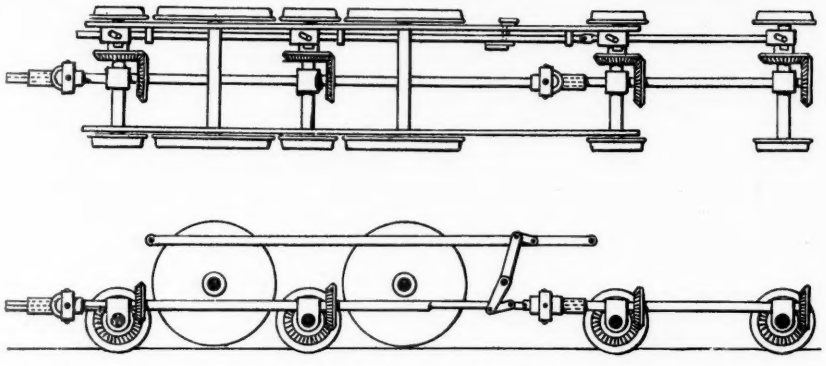
The Bothwell Locomotive.

A novel and interesting scheme for increasing locomotive tractive power and securing the additional adhesion to utilize this power, has been devised by George A. Bothwell, of Owen Sound, Ontario. Briefly, Mr. Bothwell's scheme consists in providing a second set of driving wheels of much smaller diameter than the regular drivers, to give the requisite greater tractive effort, and a system of gearing for utilizing the adhesion of the engine truck, and also of the tender, if desired. When the small drivers are on the rail the large ones are lifted clear of it and *vice versa*. The purpose of the scheme is a locomotive of maximum hauling capacity with minimum weight; that is, to provide within locomotives of the usual types means for taking over ruling grades trains which they would otherwise be unable to haul, or for which helper service would be needed.

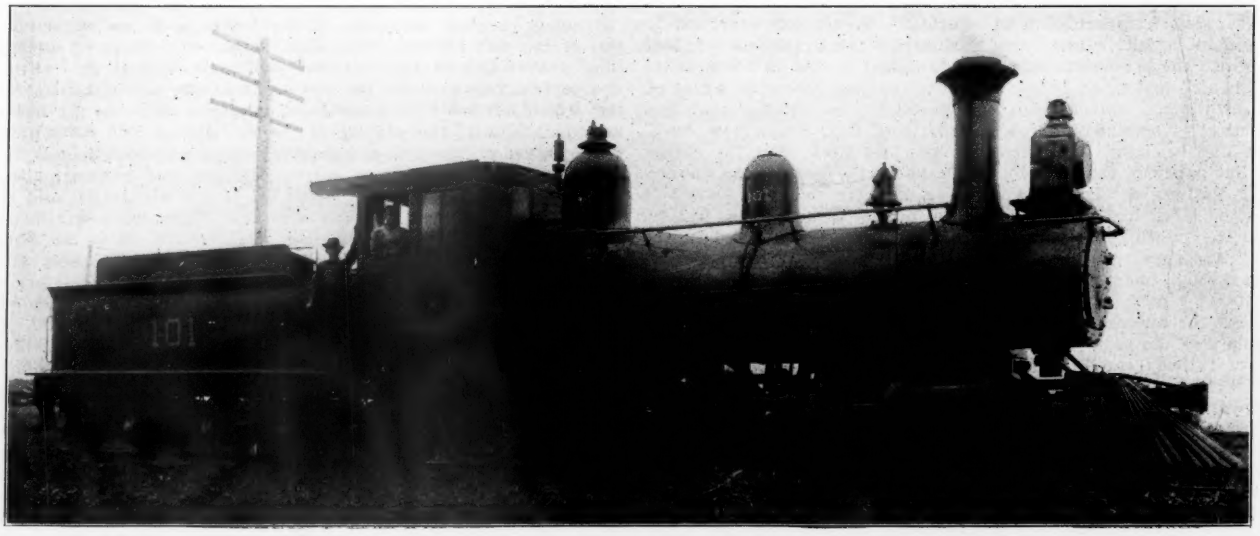
The photograph and sketches herewith show the application of the idea to an eight-wheel locomotive. The change from one system to the other is effected by a cylinder controlled from the cab and worked either by steam or air. The working of the mechanism is such that by means of suitable clutches the gearing for driving the trucks is thrown into and out of service simultaneously with the changes between drivers. The mechanical details of the scheme are very ingeniously worked out.

The locomotive shown in the illustration was rebuilt at the Hicks Locomotive & Car Works, Chicago Heights, Ill. The auxiliary drivers are 32 in., the large ones 60 in., and the engine truck only is utilized to give the extra adhesion. This engine was equipped to demonstrate the feasibility of the idea. In a test made at the works, the engine running on the large drivers stalled with 25 empty cars on the grade on which the test was made, after taking 23 cars over. With the Bothwell mechanism it took 47 cars over and stalled with 50, showing a hauling capacity of about double the ordinary.

The scheme would appear to be limited to types of locomotives having not more than three pairs of drivers, on account of the necessary lengthening of the wheel-base. However, it is the inventor's idea that with such a mogul or 10-wheeler he would be able to take over the road trains for which much more powerful locomotives are now used and which may require helper service in addition on the critical grades. He would thus have the lower first cost and operating economies and advantages of the lighter locomotive, which it is considered would more than warrant the cost and maintenance, as well as the complication, of the additional mechanism for increasing its hauling capacity when desired. The Bothwell Locomotive Co. has been formed with headquarters at Owen Sound, Ont.



Sketch of Gear Mechanism; Bothwell Locomotive.



The Bothwell Locomotive.

GENERAL NEWS SECTION

NOTES.

At a "family talk" of the Traveling and District Passenger and Freight Agents of the Wisconsin Central, which was held in Milwaukee last week, 52 traffic men employed by the company in various distant cities were present.

The Louisiana state railroad commissioners have ordered the Pontchartrain Railroad within 60 days to provide better cars for its passenger trains, and to run its trains to and from the Louisville & Nashville Central street station in New Orleans.

The principal railroads of Nevada have secured temporary injunctions against the new railroad commission of that state, forbidding it to disturb freight rates. A hearing on the question of making the injunction permanent will be given on September 16.

The Central of New Jersey has begun suit at Easton, Pa., to test the validity of the Pennsylvania law, passed this year, to go into effect October 1, reducing all passenger fares to 2 cents a mile. The Central avers that the proposed reduction would reduce its receipts $100,000 a year.

In Cole County, Missouri, the Missouri Pacific Railway has been indicted by the Grand Jury for failing to run at least one train each day over the Bagnell branch; and also, on 14 counts, for violating the law forbidding the employment of telegraph operators more than eight hours a day.

The New York, New Haven & Hartford now uses electric motors on all main line passenger trains which begin or end their trips at Portchester and New Rochelle, about 15 each way. All are suburban trains, most of them running to New York in the morning and from New York in the afternoon.

Complaint has been made to the Interstate Commerce Commission that the fare over the Michigan Central from Michigan City, Ind., to New Buffalo, Mich., 10 miles, which is 30 cents, is extortionate, to the extent of 50 per cent., 2 cents a mile being the intrastate rate both in Indiana and in Michigan.

According to a press despatch from Omaha, an order has been issued by the Union Pacific that between all stations where there is another railroad competing for passenger traffic, the rates on the Union Pacific shall be as low as those of the competitor; which will result in fares less than 2 cents a mile in many cases.

On the Mexican Central and the Mexican National Railroads second class fares and third class cars have been abolished. Henceforth there will be two classes, first and third, and the third class passengers will be carried in the cars hitherto used for second class. For third class passengers only 33 lbs. of baggage will be carried free.

The Adams Express Co. no longer does business on the Boston & Albany, and it has closed its offices at those stations between Boston and Worcester, where it has hitherto done local business, except those places which are reached also by the New York, New Haven & Hartford. The American Express now has exclusive rights on the B. & A.

The Isthmian Canal Commission announces that the excavation on the canal during July was as follows: Culebra division, 770,570 cu. yds.; Gatun, 74,765 cu. yds.; dredging in canal prism, 212,710 cu. yds.; total, 1,058,776 cu. yds., against 780,957 cu. yds. in June. This is the largest month's work yet done. The rainfall for the month is reported at 9.5 in., against 14 in. in June.

The arrests made on the Pennsylvania Railroad lines last month by the company's police numbered 638. Of these arrests, 237 were for illegal train riding. Of this number 31 paid the fare, while 107 were sent to jail and 66 were fined. The report shows that 147 arrests were made for trespassing, 63 for larceny and burglary and 13 for breaking into cars; and for stoning trains 13.

The Grand Trunk Railway has appealed to the Supreme Court against the recent order of the Canadian Railway Commission to run third-class cars on one passenger train each way daily, with tickets at 2 cents a mile. It appears that the Commission's order requires only what was required by a provision in the company's charter which, though never lawfully abrogated, has remained a dead letter.

In the Federal Court at Chicago, August 3, indictments were returned against the New York, Chicago & St. Louis and the Lehigh Valley railroads for granting illegal rebates on shipments of freight made in cars of the Overland Refrigerator Express Co. It is charged that commissions paid to the refrigerator company were used to reduce the freight bills. The alleged owners of the refrigerator cars were also indicted.

The Chicago, Milwaukee & St. Paul, the Chicago & North-Western and the Wisconsin Central have given notice that on August 15 they will reduce fares in Wisconsin to 2 cents a mile. Officers of the Wisconsin Central say that they could successfully contest in the courts a 2-cent fare law, but they submit because of the stress of competition. The Green Bay & Western, whose earnings do not bring it within the law, probably will not adopt the 2-cent fare.

At Jamaica, N. Y., last week Ralph Peters, President of the Long Island Railroad, and James A. McCrea, General Superintendent, were arrested on a criminal charge in connection with a highway crossing accident and held in $10,000 bail each to await the action of the Grand Jury. The arrests were made by order of a coroner who declared these officers criminally negligent in failing to safeguard a crossing where two persons in an automobile were killed about two weeks ago.

At Palestine, Tex., one night last week, according to a press despatch, George Brush, a citizen of the state of Kentucky, peaceably traveling in Texas, was arrested and fined $10 for taking a drink of whiskey while on a train of the International & Great Northern Railroad. According to the statement Mr. Brush had the whiskey in a flask, which he carried in his pocket, and he was only "sampling" it. In the eyes of the law, however—a law lately passed—drinking is drinking, and the drinker had to surrender to the sheriff.

The state of Arkansas, like Alabama, has a law designed to prevent railroads from transferring law suits from the state to the federal courts, the penalty being the forfeiture of the property of the company to the state. The Chicago, Rock Island & Pacific offended in this respect recently, and the Secretary of State started to apply the law; but, on application to the United States Circuit Court at St. Paul, August 5, the road secured an injunction against the Secretary of State, hearing on the injunction to be held at Little Rock, October 2.

The recent order of the state railroad commissioners of Missouri limiting the speed of trains on certain parts of the Missouri Pacific appears to have been due in considerable degree to political considerations, and parts of the order have been rescinded or suspended. Press despatches give contradictory information, so that the real facts are not made clear. It appears that there is dissension in the board, and two of the members have announced that the sections of railroad condemned are safe. The order limiting speed was made after the hearing of a complaint which was presented by an attorney for a trackmen's union.

The Wisconsin railroad commission has ordered sweeping reductions in freight rates on coal from Superior and Ashland to Eau Claire and intervening points over the Chicago, St. Paul, Minneapolis & Omaha. The reduction is about 40 cents a ton. The commission has also decided that at common points all railroads must switch each other's cars to their respective sidetracks for reasonable switching charges. They cannot charge distance tariff rates. It is also decided that a railroad acquiring a spur must so operate it as to serve the public reasonably and impartially; and again, that a certain minimum of passenger service must be maintained on a railroad regardless of the question of whether it is profitable.

The Southern Railway and other roads in Virginia have had to compromise with the Governor of that state concerning passenger fares in about the same way that they yielded to the Governor of North Carolina. In Virginia the Corporation Commission last April issued an order reducing fares to 2 cents and the railroads secured an injunction suspending the operation of the law; but on Saturday last the Governor told the railroads in substance that Virginia intended to fight for low fares on about the same plan that North Carolina has followed, and that an extra session of the legislature would be called if necessary to carry out what the Governor believes to be the wishes of the people. After a long conference the railroads agreed to reduce their fares on October 1 to 2 cents a mile, it being assumed that the United States Court would readily suspend its injunction forbidding such reduction. The railroads agreed to keep the low rate in force until the pending cases are settled by the Supreme Court of the United States, and both parties agree to secure such decision as speedily as possible. The Seaboard Air Line adopted the 2¼-cent rate for passengers in both Virginia and North Carolina on July 1. In Virginia, although the Jamestown Exposition is now stimulating travel, the receipts for passengers since the reduction have been less than in the corresponding period last year. In North Carolina the local passenger travel in July has been about 2 per cent. more than the last month while the passenger receipts have decreased 22 per cent.

A Phase of "Rapid" Transit in New York City.

Unless the Metropolitan Street Railway Company, which is now the owner of the old horse car line running from the Bartow station to City Island, on the Sound, gets some new horses to draw its cars before to-morrow, its line will be tied up. This was the order issued by the Society for the Prevention of Cruelty to Animals to-day. Of the 24 horses used on the line, one-half are about played out from old age, while others are suffering from sore shoulders. The horses have been worked on the line every day for nine years. It is bad enough to drive them over hill and dale at breakneck speed, with their rattletrap cars behind them, but in addition the horses suffer terribly from mosquito bites, as the entire country from Bartow to City Island is notorious for these pests. The company declares that it has been expecting for some time past to install electric cars but has been prevented from making this improvement because the city of New York is slow in widening and improving the street.—*New York Times.*

Blocking the Wheels of Civilization.

The Missouri, Kansas & Texas refuses to haul the Parker carnival train from Kansas City to Sedalia in the first week in October. The Missouri Pacific also refused to accept the train at Cole Camp and haul it to Sedalia. The railroads claim that they have entered into an agreement not to haul circus trains and will make no rate to haul them as circus trains, and can only accept them at the classified rates per 100 lbs., which would make the charges prohibitive. Operating officials contend that they must take special precautions with such trains and that they interfere with the movement of regular freight and cause congestion at the smaller terminals.—*Press Despatch.*

Another One.

A locomotive cab signal made by H. J. Jefcoate, of Crewe, England, was recently exhibited on the Wirral Railway, and the exhibition is described in a Consular Report as follows:

"A locomotive running 60 miles an hour, with its cab enveloped in tarpaulin, so that the engineer was entirely shut off from the outer world, was confronted by the distant signal set against it. The engine at once began to slacken and stopped dead at the home signal until the semaphore arm dropped, when it moved ahead again. The state of the signals was communicated to the engineer by an indicator in the cab, which announced them by bell, semaphore, and light. Two long bars parallel to the rails, one beginning where the other ended, were placed at both the distant and home signals, and as the engine passed over them, according as the semaphore was 'on' or 'off,' one or other of these bars rose on its pivots and pushed up one or other of two little plunger wheels which projected from the locomotive, and as it did so a bell was rung in the cab."

Railroad Course at New York University.

The New York University School of Commerce, Accounts and Finance will begin on September 26 a special one-year course in railroad traffic and accounts. The classes will be held on Monday and Thursday evenings. The following subjects will be included: Railroad accounts, corporation securities and reports, railroad transportation in the United States, and railroad traffic problems. Under the advice of railroad men of experience every effort has been made to make the course thoroughly practical.

Individual Car Owners' Association.

This is the name of an organization formed at Cleveland August 1 by 50 representatives of corporations, firms and individuals (other than railroad companies) owning freight cars, the meeting having been called by leading Pittsburg car owners. It is said that the men present at the organizing meeting represented 125,000 cars. All belong in states east of the Mississippi river. W. L. Andrews, of Baltimore, was chosen Chairman, and R. J. Bailey, of Pittsburg, Secretary. Other men prominent in the organization are: C. McIlvaine and C. O. Johnson, Pittsburg; T. J. Richman and Max Epstein, Chicago; C. D. Chamberlain, Cleveland.

Forty Passengers Killed in France.

In a derailment near Angers, France, on Sunday last, the engine, baggage car and the first passenger car of a passenger train fell off the side of a stone bridge crossing the Loire river, the parapet giving way, and all of the occupants of this part of the train, except the conductor and the fireman, were drowned. The passenger car, a third class, carried 40 passengers, and not one of them was able to get out of the car, although a part of the roof was forced off when the car sank in the water. The engineman was drowned, making 41 victims in all. The river at this place is 50 ft. below the track. The remainder of the train remained on the roadbed. Angers is at the junction of several railroads. The name of the road on which the accident occurred is not given in the press despatches.

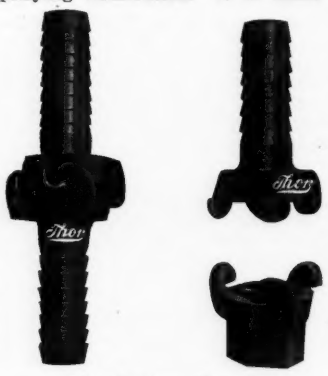
Summer in the Suburbs.

W. Hardy Eshbaugh, living in Montclair avenue, Montclair, drives in his automobile to the Lackawanna station every morning. Yesterday he had just reached the station, when the 8 o'clock express pulled out. Mr. Eshbaugh had an important engagement at his office, and he told his chauffeur to "beat the train" to Bloomfield, nearly two miles away. The machine was thrown wide open, and only a streak of dust could be seen along Bloomfield avenue. Passing through Glen Ridge at a pace that surprised the natives, the automobile drew up at the Bloomfield station four minutes ahead of the train. When the chauffeur returned to Montclair Recorder Yost fined him $5 for excessive driving.—*New York Tribune.*

The old story about the Georgia ox team that beat a mixed train in a 10-mile run will now be retired.

The "Thor" Hose Coupling.

The "Thor" hose coupling for shop use is shown in the accompanying illustration. It is made of tough bronze to stand hard usage, and it will not rust. It has three hook-shaped lugs, which are made to engage by a third of a turn and produce a tight coupling. The couplings are made for ⅜ in., ½ in., ¾ in. and 1 in. hose or pipe with the same sized head, so that large and small hose or pipe can be coupled together without using reducers. Another advantage of this feature is that should a ¾-in. hose, for instance, burst and nothing be immediately available but a 1-in. piece, say, it can be used and delay thus avoided. There are no rights and lefts, every coupling joining to any other. There are only two patterns, one being to screw on to iron pipe, and the other being for hose. The "Thor" coupling is made by the Independent Pneumatic Tool Co., Chicago.



"Thor" Hose Coupling.

New Jersey Tax Law.

The New Jersey Court of Errors and Appeals has sustained the constitutionality of the Duffield act of 1905, under which second-class railroad and canal property is assessed at local tax rates instead of 1 per cent. as formerly. Under the Duffield act the entire revenue from this class of property goes to the municipality and none of it to the state, which now derives its revenues from a part of the tax levied against "main stem" property. The main stem consists of the right of way not exceeding 100 ft. in width, and second-class property is the real estate used for railroad purposes but not included in the main stem.

The test case was instituted by the Bergen & Dundee Railroad. Its second-class property in Passaic was taxed at $2.92 per $100. This rate varies in the different municipalities of the state, but in practically every instance is a substantial increase over the 1 per cent. rate formerly paid by the railroads.

INTERSTATE COMMERCE COMMISSION RULINGS.

In an opinion by Commissioner Clements the Commission has announced its decision in the case of Quimby and others against the Clyde Steamship Company and others. It appeared that class rates from North Atlantic ports were the same to a group of suburban mills as to Augusta, Ga., for 10 or 12 years before the absorption of the South Carolina & Georgia Railroad by the Southern Railway; that subsequent to such absorption the long-existing rates to these suburban points were increased by the concerted action of the defendant carriers, though the mill group is still recognized on shipments in the opposite direction, and that this grouping system is still effective to the extent of classing together some of these suburban points which are as far apart as Augusta is from the nearest of them. It also appeared that water lines by way of the Savannah river secure most of the freight of the heavy and bulky classes for these mills, and that a restoration of the Augusta rates to these suburban points would divert much of this traffic to the

defendant lines and thus increase their revenues. The Commission held that the rates to these suburban mill points in excess of those to Augusta are, under the circumstances, unjust and unreasonable. The places ordered to be put in the Augusta group are Aiken, Langley and Graniteville, S. C.; but Blackville, S. C., 46 miles east of Augusta, was not ordered to be included in the Augusta group.

In an opinion rendered by Commissioner Clark, the Commission has announced its decision in the matter of the distribution of coal cars. The cases were brought by the Railroad Commission of Ohio against the Hocking Valley and the Wheeling & Lake Erie. Defendants are engaged principally in transportation of coal. Certain other railroads send their own cars to the coal companies with which railroads so sending their cars have contracts for fuel supply. Certain other coal operators have so-called "private" cars, devoted exclusively to their use. During a part of the year defendants are unable to furnish all of the cars desired by coal operators along their lines, and at such times the available cars not specially consigned or restricted as to use are divided among the several coal companies according to the capacities of their several mines. But in such distribution the foreign railroad fuel cars and the leased or private cars are excluded from consideration and are given to the coal companies to which they are consigned or assigned in addition to the full share of cars allotted to such mines in the proportionate distribution. Complaint alleges unjust discrimination against other coal operators along the lines of defendants, in that such distribution of cars and such failure to count the foreign railroad fuel cars and the private cars gives the coal operators to whom such cars are consigned and assigned unwarranted advantages over other operators in the mining and marketing of coal.

Upon the foregoing facts the Commission held that a carrier should give to the owner or lessee of private cars the use of such cars; and should also give to a coal company the foreign railroad fuel cars consigned to it; but that such private and foreign railroad fuel cars should, in the distribution of cars, be counted solely against the company to which delivered; and such company should not be given, in addition to such delivery, a share of the system cars (H. V. or W. & L. E.) except when the number of private and foreign railroad fuel cars so delivered to it is less than its distributive share of the available cars, including system cars, foreign railroad fuel cars, and so-called private cars, in which event it should be given only so many of the system cars as are necessary, when added to the number of private and foreign railroad fuel cars assigned to it, to make up its distributive share of the total available cars, including system cars, foreign railroad fuel cars, and so-called private cars. Defendants were ordered to distribute coal cars after Sept. 15 next on the basis here laid down.

TRADE CATALOGUES.

Storage Batteries.—The Gould Storage Battery Co., New York, is introducing a new design storage battery for small installations of closed circuit duty such as fire alarm and railroad telegraph systems, private telephone exchanges, etc., which is described in a recent catalogue. It is known as the "Tandem" couple type cell and it differs from other types in that the plates are placed end to end instead of side by side. Two plates only are used to each cell. The positive plate of one cell is lead burned to the negative plate of the next cell and no bolted connections are used. This method of grouping does away with separators and distributes the discharge and hence the wear and tear uniformly over all parts of both sides of the plates in each cell. The removal of plates for cleaning, inspection or renewal is also facilitated.

Storage Batteries.—Catalogue S-2 of the Westinghouse Machine Co., East Pittsburg, Pa., illustrates and describes the Westinghouse Type "S" storage battery for stationary service. This battery is of the pure lead sulphuric acid type with the active material formed from the lead itself after the Planté process. The advantages claimed for it are long life, high efficiency and freedom from injurious sulphation.

Mining Hoists.—Bulletin No. 56 of the Sullivan Machinery Co., Chicago, shows a number of views of typical installations of the large and powerful types of mining hoists developed in response to the demands of the Lake Superior iron and copper mines and now generally used in the West. There is also a brief description and a list of the advantages of the Sullivan machines.

MANUFACTURING AND BUSINESS.

The Falls Hollow Staybolt Co., Cuyahoga Falls, Ohio, is building a new mill of three times the capacity of the present mill.

Wilbur J. Watson, C. E., hitherto in charge of the bridge department of the Osborne Engineering Co., Cleveland, Ohio, has resigned to go into general contracting work.

The Northern Engineering Works, crane builders, Detroit, Mich., have installed a power station crane of 20 tons capacity for the Toledo Gas & Electric Co., and two of 20 tons capacity in the Murphy power plant at Detroit, Mich.

G. N. Sweringen, chief clerk to the General Superintendent of Motive Power of the Rock Island system, was appointed Manager of Sales in the railroad department of the McMaster-Carr Supply Co., 174-176 E. Lake street, Chicago, on August 1.

On July 31, 1907, in the Circuit Court of the United States, district of New Jersey, a decision was rendered in favor of the Ajax Metal Company, of Philadelphia, Pa., and Birmingham, Ala., relative to infringement made upon their patent covering plastic bronze.

The Central Inspection Bureau, New York City, has resident inspectors at the works of the Cincinnati Car Co., Cincinnati, Ohio; the Southern Car Co., High Point, N. C.; the Jewett Car Co., Newark, Ohio; the Niles Car & Manufacturing Co., Niles, Ohio, and at the J. G. Brill Company's plants.

E. H. Keating, M. Inst. C. E., M. Can. Soc. C. E., M. Am. Soc. C. E., and W. H. Breithaupt, C. E., M. Can. Soc. C. E., M. Am. Soc. C. E., have formed a partnership, with offices at Toronto, Ont., as Consulting Engineers, taking up railroad and municipal work, power development, bridges, foundations, buildings, etc., in Canada and other countries.

The mid-summer meeting of local managers and representatives from the Chicago house of The Sherwin-Williams Co. was held at the South Shore Country Club, Chicago, August 2. There were about 50 persons present, including Alex. Sclater, District General Manager of the company; Geo. A. Martin, Manager of the Cleveland district; J. P. Coleman, Manager of the Minneapolis district, and R. W. Sample, Manager of the Chicago district. There were talks by these managers and remarks from others among the representatives, following a dinner, after which the time was given up to social enjoyment.

In July the railroad department of the Westinghouse Electric Company, East Pittsburg, Pa., booked orders for about $2,500,000 worth of equipment. The Brooklyn Rapid Transit ordered 400 motors, 200 of which, of 200-h.p. each, are for 100 elevated railroad cars, while the rest, of 60 h.p. each, are for 100 surface cars. The cars were ordered last March. In connection with the elevated car equipment, the company will also furnish the Westinghouse multiple unit control. The Schoepf interests, of Cincinnati, Ohio, ordered a complete equipment of electrical apparatus for 24 substations, consisting of rotary transformers and switchboard appliances as well as four Westinghouse turbo-generators, aggregating 26,000 h.p.

Iron and Steel.

The Interborough Rapid Transit Company is in the market for 4,000 tons of rails.

The Southern has ordered 16,000 tons of bridge material from the Phoenix Bridge Co.

The Northern Pacific has ordered nearly 15,000 tons of steel for bridges from the American Bridge Co.

The Terminal Railroad Association of St. Louis has ordered 2,500 tons of bridge material from a St. Louis firm.

The New York, New Haven & Hartford has ordered 1,400 tons of steel for a Scherzer lift bridge at Providence from the Phoenix Iron Works.

The Atlanta, Birmingham & Atlantic has ordered steel for a number of bridges on its new line near Birmingham, from the American Bridge Co.

The Pennsylvania has ordered 750 tons of steel for bridges across streets in connection with the New York terminal, and 625 tons for the Duquesne Way elevated viaduct in Pittsburg.

It is reported from Chicago that an Illinois electric railroad has ordered 25,000 tons of rails for this year's delivery, and that other traction companies are in the market for from 5,000 to 10,000 tons.

The Detroit & Adrian Traction Co., a new company which is projecting a 61-mile interurban line in Michigan, is reported to be in the market for about 6,500 tons of 71-lb. rails. Address care of Security Trust Co., Detroit.

The Atchison, Topeka & Santa Fe has ordered 10,000 tons of rails from the Pennsylvania Steel Co. for 1908 delivery. This makes 40,000 tons that this company has bought for next year's delivery, the other 30,000 tons having been ordered from the Bethlehem Steel Co.

ELECTIONS AND APPOINTMENTS.

Executive, Financial and Legal Officers.

Alabama Great Southern.—See Cincinnati, New Orleans & Texas Pacific.

Central New England.—The authority of the following officials of the New York, New Haven & Hartford has been extended over the Central New England: H. M. Kochersperger, Vice-President; H. A. Fabian, Assistant to the President, and Thomas F. Paradise, Assistant to the Treasurer.

Cincinnati, New Orleans & Texas Pacific.—T. C. Powell, Vice-President of the Southern, has been elected also Vice-President of the C., N. O. & T. P., and of the Alabama Great Southern, with office at Cincinnati, Ohio, in charge of the operating department and purchasing department. W. J. Murphy, Vice-President, will be the resident executive officer at Cincinnati.

Escanaba & Lake Superior.—Edward Wicking has been appointed Auditor, with office at Wells, Mich., succeeding C. W. Kates, transferred. See this company under Operating Officers.

New Orleans, Ft. Jackson & Grand Isle.—F. T. Howard has been elected President, succeeding H. C. Warmoth, resigned.

New York, New Haven & Hartford.—See Central New England.

Susquehanna, Bloomsburg & Berwick.—H. R. Slifer has been appointed Auditor, with office at Watsontown, Pa.

Wisconsin State Railroad Commission.—John H. Roemer, of Milwaukee, has been appointed Chairman, succeeding John Barnes, resigned.

Operating Officers.

Atlantic Coast Line.—W. B. Darrow, Superintendent of the Southern at Jacksonville, Fla., has been appointed Superintendent of Transportation of the First division of the Atlantic Coast Line, with office at Rocky Mount, N. C. F. T. Bowles has been appointed Superintendent of Terminals, with office at South Rocky Mount, N. C. R. C. Westcott has been appointed Trainmaster of the Richmond district, with office at Richmond, Va., succeeding E. C. Lucas, resigned.

Canadian Pacific.—J. T. Arundel, Superintendent at Winnipeg, Man., has been appointed Superintendent at Vancouver, B. C. A. L. Clements has been appointed Superintendent of Terminals at Vancouver.

Chicago & Illinois Midland.—W. S. Cook has been appointed Superintendent, with office at Pawnee, Ill., succeeding M. A. Zook.

Chicago, Rock Island & Gulf.—D. Van Hecke has been appointed Assistant Trainmaster of that part of the Mexican division from Dalhart, Tex., east. G. W. Keene has been appointed Assistant Trainmaster in charge of the line from Dalhart west.

Erie.—A. J. Stone, Assistant General Manager, has been appointed General Superintendent, with office at Jersey City, N. J., succeeding R. H. Bowron, resigned, and the office of Assistant General Manager has been abolished.

Escanaba & Lake Superior.—Charles W. Kates, Auditor, has been appointed Superintendent, with office at Wells, Mich., succeeding Wesley E. Wells, resigned to become Manager of the John O'Brien Lumber Co., Somers, Mont.

Interoceanic of Mexico.—E. W. Thompson has been appointed Trainmaster at Puebla, succeeding E. W. Bowans, resigned to go to the National of Mexico.

Lehigh Valley.—G. B. Minshull has been appointed Inspector of Transportation, succeeding W. D. Vincent, transferred.

Louisville, Henderson & St. Louis.—W. R. Hensley has been appointed Car Accountant, with office at Louisville, Ky., succeeding Ridgely Case, assigned to other duties.

McCloud River.—J. C. Wilder has been appointed Superintendent, with office at McCloud, Cal., succeeding M. H. Burkhalter, deceased.

Minnesota & International.—The office of the General Manager has been moved from St. Paul, Minn., to Brainerd, Minn.

New York Central & Hudson River.—F. E. Williamson, Assistant Superintendent of the Harlem division, has been appointed to the new office of Superintendent of Freight Terminals at Albany, N. Y.

Oklahoma Central.—F. C. Hand, Chief Engineer, has been appointed also General Superintendent.

Southern.—J. A. Baumgardner has been appointed Superintendent at Jacksonville, Fla., succeeding W. B. Darrow, resigned to go to the Atlantic Coast Line. See Atlantic Coast Line.

Traffic Officers.

Baltimore & Ohio.—Edward M. Davis, division freight agent at Baltimore, Md., has been appointed General Eastern Freight Agent, with office at New York, succeeding F. M. Johnson, resigned.

Birmingham & Atlantic.—H. J. Meade has been appointed General Freight and Passenger Agent, succeeding W. M. Tarpley, resigned.

Cumberland & Pennsylvania.—J. T. Robertson has been appointed General Passenger and Freight Agent.

Litchfield & Madison.—F. M. Campbell has been appointed General Freight Agent, with office at Edwardsville, Ill.

Mexican International.—Fritz Niggli, General Agent at Torreon, has resigned to go into other business.

Engineering and Rolling Stock Officers.

Atlantic Coast Line.—L. L. Sparrow has been appointed Engineer of Roadway of the First division, with office at Rocky Mount, N. C.

Chicago, Indiana & Southern.—L. Slattery has been appointed Signal Engineer, with office at Gibson, Ind., succeeding Byron Layton.

Kalamazoo, Lake Shore & Chicago.—W. K. Christie has been appointed Master Mechanic, with office at South Haven, Mich.

Kingston & Pembroke.—G. G. Hare has been appointed Chief Engineer, succeeding T. W. Nash.

New York, Chicago & St. Louis.—W. J. Bergen, Chief Supervisor of Track, has been appointed Assistant to the Chief Engineer, with office at Cleveland, Ohio. C. B. Hoyt succeeds to the duties of Mr. Bergen with the title Superintendent of Track Maintenance and Construction, reporting to the General Manager.

New York, New Haven & Hartford.—W. L. Larry, Master Mechanic at Taunton, Mass., has resigned to become an inspector for the Massachusetts State Railroad Commissioners.

Northern Central.—See Philadelphia, Baltimore & Washington.

Pennsylvania.—George D. Fowle, Signal Engineer of this company and of the Philadelphia, Baltimore & Washington, the Northern Central and the West Jersey & Seashore, has been appointed Consulting Signal Engineer of the three companies. A. H. Rudd, Assistant Signal Engineer, succeeds Mr. Fowle. C. C. Anthony, inspector of signals, succeeds Mr. Rudd.

Philadelphia, Baltimore & Washington.—See Pennsylvania.

West Jersey & Seashore.—See Philadelphia, Baltimore & Washington.

Purchasing Agents.

Seaboard Air Line.—W. M. Portlock has been appointed General Storekeeper, with office at Portsmouth, Va., succeeding R. E. Dickinson, resigned to go to another company.

Special Officers.

St. Louis & San Francisco.—Dr. Herman Von Schrenk has been appointed Supervisor of Timber Preservation, with office at St. Louis, Mo.

LOCOMOTIVE BUILDING.

The Las Vegas & Tonopah has ordered four locomotives.

The Northern Pacific is said to be in the market for five switch engines.

The Galveston, Houston & Henderson is said to be in the market for two switching locomotives.

The Sandy Run Lumber Company, Norfolk, Va., is said to be in the market for one locomotive.

The Great Northern has ordered two rotary snow plows from the American Locomotive Company.

Jones & Laughlin have ordered one 4-wheel tank locomotive from the American Locomotive Company.

Swift & Co., Chicago, it is said, are having one locomotive built by the Baldwin Locomotive Works.

The Tombigbee Valley, it is said, has ordered two locomotives from the Baldwin Locomotive Works.

The Nevada, California & Oregon, it is said, has ordered one locomotive from the Baldwin Locomotive Works.

The Escanaba & Lake Superior, it is said, is having one locomotive built by the Baldwin Locomotive Works.

The Detroit & Toledo Shore Line, it is said, has ordered four locomotives from the Baldwin Locomotive Works.

The Wichita Falls & Northwestern has ordered two mogul locomotives from the American Locomotive Company.

The Chilian Government is said to have bought 25 heavy locomotives from the American Locomotive Company.

The Chicago & North-Western, it is said, is having 20 additional locomotives built by the Baldwin Locomotive Works.

The American Steel & Wire Company is said to have ordered one locomotive from the Baldwin Locomotive Works.

The Wickwire Steel Company, Cortland, N. Y., has ordered one 4-wheel tank locomotive from the American Locomotive Company.

The Kiangsu Railway, Japan, has ordered through Mitsui & Co., New York, three mogul locomotives from the American Locomotive Company.

The San Antonio Madruga Plantation, Cuba, has ordered through the Czarnikow, MacDougall Company, New York, one mogul locomotive from the American Locomotive Company.

The San Pedro, Los Angeles & Salt Lake recently ordered 23 simple consolidation locomotives from the American Locomotive Company for November and December, 1907, delivery. These locomotives will weigh 208,000 lbs., with 187,000 lbs. on drivers; cylinders, 22 in. x 30 in.

CAR BUILDING.

The Las Vegas & Tonopah has ordered 10 tank cars.

The San Pedro, Los Angeles & Salt Lake has ordered 110 tank cars.

The Northwestern Elevated, Chicago, will buy 50 additional cars in the near future.

The Northwestern Pacific recently asked prices on 200 steel underframe flat cars.

Charles Clarke & Co., Galveston, Tex., are in the market for narrow gage side dump cars.

The Cold Blast Transportation Company, Chicago, has ordered 200 stock cars from Haskell & Barker.

The Texas Central is said to have ordered three sleepers from the American Car & Foundry Company.

The Erie denies being in the market for freight equipment, as reported in the *Railroad Gazette* of August 2.

The San Antonio & Aransas Pass, as reported in the *Railroad Gazette* of July 26, is asking prices on 500 box cars.

The Connecticut Electric Company has ordered seven double-truck derrick cars from the McGuire, Cummings Manufacturing Company.

The Chicago, Burlington & Quincy, as reported in the *Railroad Gazette* of July 26, recently ordered 1,000 steel gondola cars of 100,000 lbs. capacity from the Bettendorf Axle Company.

The Union Pacific has ordered 25 all steel box cars similar to the experimental car built at its Omaha shops. The company is building 22 gasolene cars and will shortly start building more.

The Interborough Rapid Transit has ordered two steel underframe snow sweepers mounted on McGuire, Cummings heavy pedestal trucks from the McGuire, Cummings Manufacturing Company.

The New York & Long Island Traction, Long Island City, N. Y., has ordered three steel underframe snow sweepers, mounted on McGuire, Cummings heavy pedestal trucks, from the McGuire, Cummings Manufacturing Company.

The Delaware, Lackawanna & Western is reported to be in the market for freight equipment. The company has not ordered one chair car, as reported in the *Railroad Gazette* of August 2, and the order for one baggage and mail car, also reported on that date, is an old order.

The Louisville & Nashville, as reported in the *Railroad Gazette* of August 2, will build at its own shops the following equipment during the present year: Six hundred 36-ft. box cars of 65,000 lbs. capacity; 700 36-ft. drop bottom gondolas of 80,000 lbs. capacity; 350 40-ft. flat cars of 80,000 lbs. capacity; 250 30-ft. double hopper ore cars of 100,000 lbs. capacity, and 100 40-ft. refrigerator cars of 50,000 lbs. capacity. During the first half of next year it will build: Four hundred 36-ft. box cars of 65,000 lbs. capacity; 350 36-ft. drop bottom gondolas of 80,000 lbs. capacity; 100 40-ft. flat cars of 80,000 lbs. capacity; 50 30-ft. double hopper ore cars of 100,000 lbs. capacity, and 100 40-ft. refrigerator cars of 50,000 lbs. capacity.

The Intercolonial has ordered 400 box cars of 60,000 lbs. capacity from the Crossen Manufacturing Company. These cars will weigh 34,800 lbs. and will measure 36 ft. long, 8 ft. 6 in. wide and 8 ft. high, inside measurements, and 36 ft. 9⅝ in. long, 9 ft. ⅝ in. wide and 13 ft. 5 in. high, over all. Bodies and underframes will be of wood. The special equipment includes:

Bolsters	Simplex
Brake-beams	Simplex
Brake-shoes	Christy
Brakes	Westinghouse
Brasses	Canadian Bronze Co.
Door fastenings	National Malleable Castings Co., "Security"
Doors	Intercolonial standard
Draft rigging	Miner tandem
Dust guards	"Positive"
Journal boxes	McCord
Paint	Red oxide
Roofs	Chicago
Trucks	Intercolonial standard

The Isthmian Canal Commission, as reported in the *Railroad Gazette* of August 2, has received bids on 500 dump cars of 12 cu. yds. capacity and 115 dump cars of 4 cu. yds. capacity. The bids on the larger cars were as follows: American Car & Foundry Company, $524,000; Kilbourne & Jacobs Manufacturing Co., of Columbus, Ohio, $215,000 for 100 cars; Arthur Koppel, Pittsburg, Pa., $665,000; William J. Oliver Manufacturing Co., Knoxville, Tenn., $562,000; Russell Wheel & Foundry Co., Detroit, Mich., $697,500; Standard Steel Car Company, $622,500; Western Wheel & Scraper Co., Aurora, Ill., $645,000. On the smaller cars the bids were as follows: Continental Car & Equipment Co., New York, $19,500; Kilbourne & Jacobs Manufacturing Co., $25,875; Kilgore Peteller Co., Minneapolis, Minn., $28,635; Arthur Koppel, $34,500; William J. Oliver Manufacturing Co., $24,725; Western Wheel & Scraper Co., $25,415.

RAILROAD STRUCTURES.

ARMOURDALE, KAN.—The Chicago, Rock Island & Pacific has begun work on shops that will cost $585,000, including a 27-stall roundhouse to cost $58,000. The plant will give employment to 1,500 men.

CLINTON, IOWA.—The Chicago & North-Western is reported to have let the contract for its new double-track steel bridge two miles long across the Mississippi.

DAUPHIN, MAN.—The Canadian Northern is to build a new roundhouse and make other improvements.

FORT WILLIAM, ONT.—The Canadian Pacific is said to be planning a coal handling plant here to cost $1,250,000.

KAMLOOPS, B. C.—The Canadian Pacific is getting bids on a station, freight house and oil house.

MACON, GA.—The Central of Georgia has let the contracts for shops to cost $1,400,000 to the McKenzie DeLeon Construction Co., Savannah.

PORT ARTHUR, ONT.—The Grand Trunk Pacific is said to have bought a block of land as a site for a passenger station and freight houses.

SAN ANTONIO, TEX.—The International & Great Northern is reported to have let the contract for its new passenger station to the Stewart Construction Company of St. Louis, Mo.

SASKATOON, SASK.—The Canadian Pacific is getting bids on a station and freight shed.

SPRINGFIELD, MO.—Bids were opened in St. Louis, on July 27, for a freight depot to be built here for the Missouri Pacific. Plans are being prepared for a passenger station to cost $65,000.

SUPERIOR, WIS.—The Great Northern is to build shops here for making steel, ore and freight cars. The cost of the plant is estimated at $200,000.

The Great Northern is reported to have let the contract for new shops for building ore cars to Schmidt Brothers & Hill.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

ATLANTA, BIRMINGHAM & ATLANTIC.—The Third division has been extended from La Grange, Ga., west to Roanoke, Ala., 25 miles.

ATLANTIC & GULF TRANSPORTATION CO.—Chartered in Texas to build in Orange, Chambers, Harris, Galveston, Brazoria, Matagorda, Jackson, Victoria, Calhoun, Refugio, San Patricio, Neuces and Cameron counties. Alfred A. Glazier, Boston; J. P. Underwood, Chicago, and J. S. Macnamara, C. M. Teagle and J. M. Conley, of Beaumont, Tex., incorporators.

COLORADO & SOUTHERN.—A new branch from Marshall, Colo., to Eldorado Springs, three miles, has been opened for business.

DETROIT & ADRIAN TRACTION.—This company has been organized with $2,000,000 capital to build an electric road on a private right-of-way from Detroit to Adrian, 61 miles.

Eureka Hill.—An officer writes that this steam road, which is to be operated by Shay locomotives, is to run from Silver City, Utah, via Dragon Hollow to the Beck tunnel and Colorado mine, 8½ miles main line. Contracts have been let for everything but track laying. Grading is now under way by N. Straw, of Springville, Utah. The work is mostly in rock; maximum grade is to be 5 per cent. and maximum curvature 40 per cent. Rolling stock has already been purchased. R. B. West, Silver City, Utah, Chief Engineer; C. W. Nibley, Salt Lake City, President.

Georgia Roads (Electric).—An interurban line from Atlanta, Ga., to Augusta, 160 miles, is projected. Surveys are being made by the Carolina Construction Company, of which James W. English, President of the Fourth National Bank of Atlanta, is President.

An electric road is projected from Augusta, Ga., to Aiken, S. C., 17 miles. The Carolina Light & Power Company, of Henderson Shoals, S. C., will furnish the power.

Great Southwestern.—Chartered in Oklahoma to build from St. Louis, Mo., to El Paso, Tex., 1,500 miles. The line is to pass through Missouri, Arkansas, Indian Territory, striking Sallisaw and McAlester, in Indian Territory, and Comanche county in Oklahoma. Offices at Oklahoma City and Wagoner, Ind. T. H. P. Moseley and R. B. Moseley, of Muskogee; A. L. Gibbs and Peter Diechman, of Wagoner; John B. Yanger and L. C. Donica, of Oklahoma City, incorporators.

Greenville & Knoxville.—This road is now in operation from Greenville, S. C., to Travelers Rest, 10 miles.

Interstate Transfer Railway.—Organized in Wisconsin to build from Superior, Wis., to Duluth, Minn. Thomas F. Cole, of Duluth, is a Director. Reported to be in the interest of the United States Steel Corporation.

Kansas City, Mexico & Orient.—Train service on the Mountain division (in Mexico) has been extended from Aguatos, Chihuahua, to Creel, on the Mexican Central, seven miles.

Lewiston & Southeastern (Electric).—The final survey of the section of this Idaho road between the Waha plateau and the Craig mountain elevations has been completed. See Construction Record.

Long Island.—The Board of Estimate and Apportionment of New York City has granted a franchise for the Glendale cut-off between Glendale Junction and Woodside at the entrance to Sunnyside Yard in Long Island City. Aside from its relation to the Sunnyside Yard project, which is an important feature of the Pennsylvania's tunnel operations, the cut-off will make possible further electrification of the Long Island's lines. The cut-off is to be a four-track line. It will enable freight and passenger traffic between the East river tunnels and the main lines south and west to be separated. Between Glendale Junction and the tunnels all passenger traffic is to go by the new line, while freight from Long Island City for points on Long Island will be handled over the existing lines. More direct handling of traffic from the Rockaway division to the Pennsylvania terminal in Manhattan will also be made possible. All grade crossings between Jamaica and Woodside will be eliminated.

McAlester Southwestern.—Organized to build from Sallisaw, Ind. T., to the Red river, in Comanche county, Okla. A. S. McKenon, Dr. E. N. Allen and C. F. Dawley, of McAlester, Ind. T., incorporators.

New York Central & Hudson River.—The contract for eliminating all grade crossings in Buffalo is reported to have been let to the Eyr-Shoemaker Corporation of Philadelphia, whose bid was $4,000,000.

Oklahoma Central.—An extension has been built from Purcell, Ind. T., to Blanchard, 19 miles. It is projected 23 miles further to Chickasha.

Oregon Trunk Line.—This is the name of a company which is to be incorporated by Seattle men to build a road from The Dalles, Ore., through the canyon of the Deschutes river, 125 miles.

St. Louis & San Francisco.—Work has been begun at a point between Fort Smith, Ark., and Fayetteville, near Winslow, on three new steel viaducts. The first, near milepost 376 (from St. Louis), will be 780 ft. long; the second, near milepost 377, 420 ft. long, and the third, near milepost 378, 450 ft. long. The extreme height of any one of them is 125 ft.

San Pedro, Los Angeles & Salt Lake.—This company is reported to have ordered about a dozen steel bridges to be used to bridge parts of the Meadow Valley wash where the line was broken by floods last spring.

South Dakota Central.—An extension has been put in operation from Rutland, S. Dak., to Nunda, six miles.

Tallulah Falls.—An extension has been built from Prentiss, N. C., to Franklin, four miles.

Virginian Railway.—Trains on this road, the consolidation of the Tidewater and the Deepwater railroads, now run into Norfolk, Va. Two sections of the line have recently been finished, one from Jarratt, Va., west to Victoria, 46 miles; the other from Mullens, W. Va., south to Matoaka, 21 miles.

RAILROAD CORPORATION NEWS.

Atchison, Topeka & Santa Fe.—Gross earnings for the month of June, 1907, were $7,856,592, an increase of $1,128,505; net earnings, $2,932,614, an increase of $191,518. With an average operated mileage of 9,273 miles, an increase of 120 miles, the gross earnings for the year ended June 30, 1907, were $93,683,407, an increase of $12,882,397; net earnings $34,815,506, an increase of $4,022,981.

Chesapeake & Ohio.—At a special meeting on August 1 the stockholders authorized the mortgage securing $10,000,000, 10-year, 5 per cent. general equipment and improvement bonds. Of these bonds, $6,000,000 are to be used as security for the $5,000,000, three-year, 6 per cent. notes sold last June. (July 5, p. 28.)

Chicago Great Western.—It is said that President Stickney and Vice-President Oppenheim, who are now in London, are arranging with foreign interests a plan to take care of the road's capital needs for the next 10 years.

Illinois Central.—Gross earnings for the year ended June 30, 1907, were $56,610,633, an increase of $4,974,228; net earnings, after taxes, $16,545,108, an increase of $1,346,173.

Kansas City Railway & Light.—This company is offering to stockholders, for subscription at 95, to the extent of 22 per cent. of their holdings, $4,125,000, series A, 6 per cent. notes maturing September 1, 1912, and convertible after September 1, 1908, into 6½ shares of common and seven shares of preferred stock. The company is also issuing $1,375,000, series B, 6 per cent. notes. The proceeds of the sale are to be used to retire $3,000,000 notes falling due next December and to retire floating debt. Both classes are secured on $2,695,000 Kansas City Railway & Light common stock, $5,500,000 Metropolitan Street Railway Company of Kansas City notes, $1,000,000 Kansas City Electric Light Company notes, and securities of other subsidiary companies. The Kansas City Railway & Light controls all the 234 miles of street railway, as well as the electric lighting and power plants of Kansas City.

Minneapolis, St. Paul & Sault Ste. Marie.—Gross earnings for the year ended June 30, 1907, were $12,892,079, an increase of $1,317,617; net earnings $5,458,530, a decrease of $331,372.

Pere Marquette.—See Toledo Railway & Terminal.

Philadelphia, Baltimore & Washington.—The stockholders have authorized the issue of $5,000,000 bonds. The proceeds of the sale of these securities will be used to pay the company's share of the cost of terminal improvements in Washington and for other construction and equipment. There are outstanding $10,570,000 first mortgage bonds of a total authorized issue of $20,000,000, the remainder being reserved to retire older securities.

St. Louis Southwestern.—Gross earnings for June, 1907, were $855,804, an increase of $129,819; net earnings, $274,375, an increase of $86,787. Gross earnings for the year ended June 30, 1907, were $10,553,135, an increase of $1,563,571; net earnings $3,357,032, an increase of $1,066,912.

Southern Pacific.—A quarterly dividend of 1½ per cent. has been declared on the $197,849,258 common stock, raising the annual rate from 5 per cent. to 6 per cent. The first dividend on this stock was the 2½ per cent. semi-annual distribution made last fall.

Toledo Railway & Terminal.—The foreclosure sale of this property to the bond holders' protective committee for $2,000,000 has been confirmed. Pere Marquette stockholders, however, will take steps to bring suit against the interests concerned in the sale in order to recover more of their losses incurred in the acquisition of the company by the Pere Marquette and the Cincinnati, Hamilton & Dayton.

Union Pacific.—Gross earnings for the month of June, including those of the Oregon Short Line and the Oregon Railroad & Navigation Company, were $6,585,692, an increase of $1,078,411; net earnings, after taxes, $2,639,273, an increase of $439,677. With 5,610 average miles of road operated, an increase of 207 miles, the gross earnings for the year ended June 30, 1907, were $76,040,727, an increase of $8,759,184; net earnings, after taxes, $33,396,103, an increase of $3,078,334.